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Illustrated articles are designated by an asterisk (*), editorials by a dagger (†), and industrials by two daggers (††).

Q

R

S

T

U

V

W

INDEX

Y

Z

Authors' Index

JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy.

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SOME SUGGESTIONS IN DAM DESIGN

By Lars Jorgensen

So far it has been considered standard practice to design a concrete or masonry dam in such a way that the lines of pressure, reservoir empty, and reservoir full, fell within the middle third of the section. By figuring sections of several dams, it occurred to the writer that this theory does not necessarily give the best profile.

A Mountain Reservoir

Figure 1a and 1b shows a profile of a cyclopean concrete dam calculated from the usual formulae given in Mr. E. Wegmann's excellent book, "Design and Construction of Dams," and other books and checked graphically. In connection with these formulae, Prof. Rankine's values for the limiting pressures along the down and up stream face are used. They are about 16,000 lbs. per square ft., or 111 lbs. per square inch for the down stream face and 20,000 lbs. per square ft., or 139 lbs. per square inch for the up stream face. These pressures were decided upon thirty years ago. Today the ultimate compressive strength of concrete, 1:3½:8, is about 2,000 lbs. per square inch six months old. It would, therefore, seem perfectly safe to use values at least twice as high as was customary thirty years ago. In all other construction work compressive stresses three times as high are considered safe for concrete, and for a dam with its large mass of concrete, it certainly seems safe to use a high compression at least twice the usual, on account of the lateral support of the central portion of the concrete.

A concrete dam is built on solid rock, or solid material,

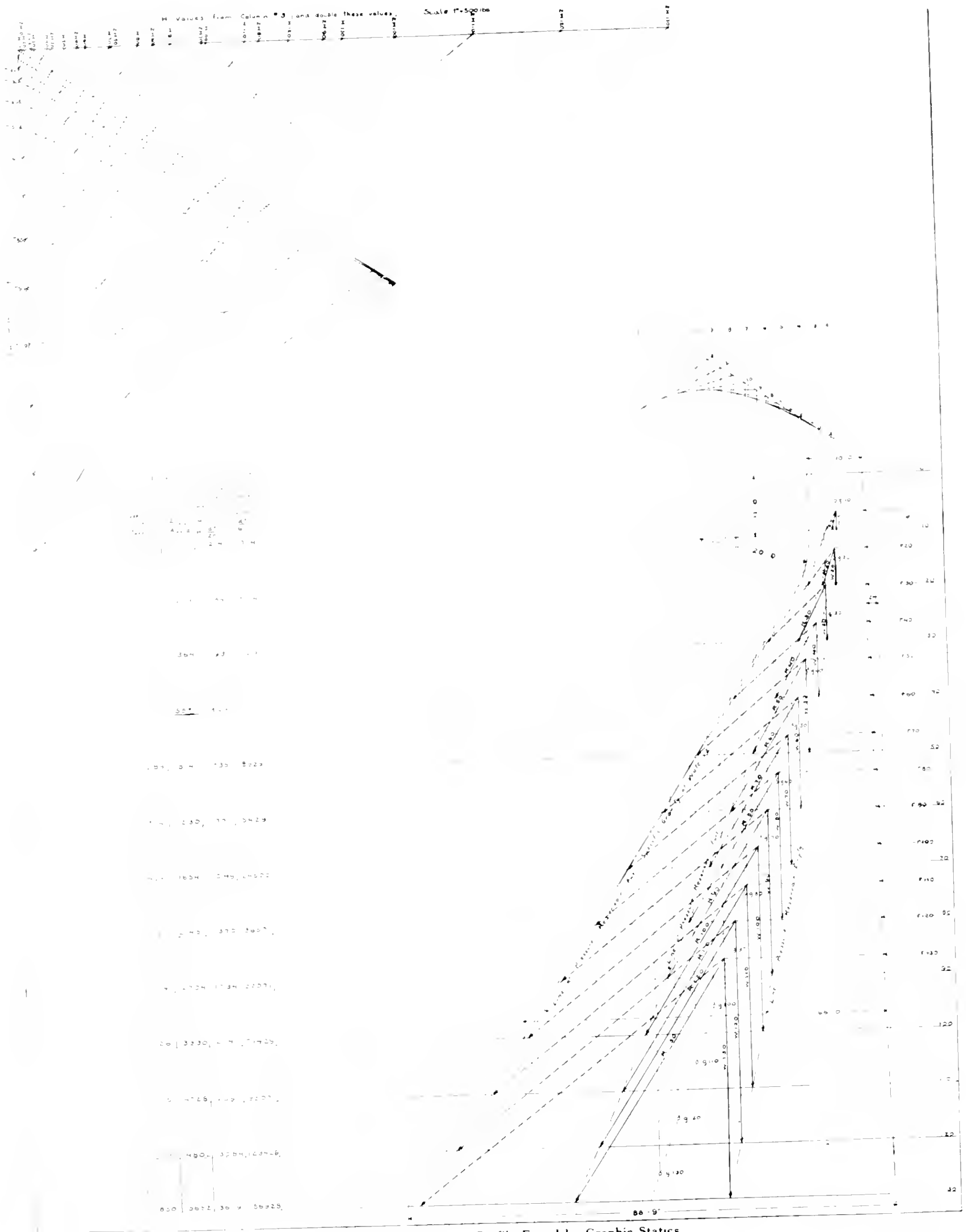

Fig. 1a. Stability of Dam Profile Found by Graphic Statics

The profile is divided into courses 10 ft. apart, and the centers of gravity of the different courses found in any usual way. The weight of each course is given in column No. 1 and the horizontal water pressure in column No. 3. From these values the force polygon is drawn and the resultant of the forces acting upon the dam found. The point of the line of pressure will be where these resultants intersect their respective joints. The diagram should be self-explanatory.

otherwise it has no place there. Solid rock is not elastic, but will safely support 60 tons per square foot, and possibly twice that, before the elastic limit is reached, or three times as much as the concrete. As the usual formulae are derived under the assumption that the foundation is elastic, they give too safe results for the up stream face. The pressure along this face is found from the formula $p = \frac{2W}{l}\left(2 - \frac{3u}{l}\right)$ (See Fig 2 for explanation.)

Formulae 1, 2, 3, 4, 5 are taken from Mr. Wegmann's book, pages 14, 21, 22 and 23, fifth edition, where full explanation can be found.

If, however $u < \frac{l}{3}$, we should have tension in the down stream toe according to the theory of uniformly varying stress on which the formula is based. As the foundation is by no means elastic, no such thing as tension from this cause in the toe seems possible.

and not when the reservoir is empty. With a perfectly vertical face 276 feet high the factor of safety with the reservoir empty would be $\frac{2000}{278} = 7.2$ For practical reasons it might be desirable to slope the face slightly, for instance, 1 ft. in 50 ft., to insure the facing (stone facing or a sheet of watertight concrete) to be on the main dam body by means of gravity. This facing should be watertight to prevent water from seeping into the mass of the dam, exerting an upward pressure, tending to overturn the dam. About the only way to make and to keep the face watertight would be to have a layer of watertight concrete on the up stream face. This sheet should not be attached solidly to the main body of the dam, but should be separated by means of a layer of broken stone about 1 inch thick and be anchored to the main body of the dam only often enough to prevent its falling off when the reservoir is empty.

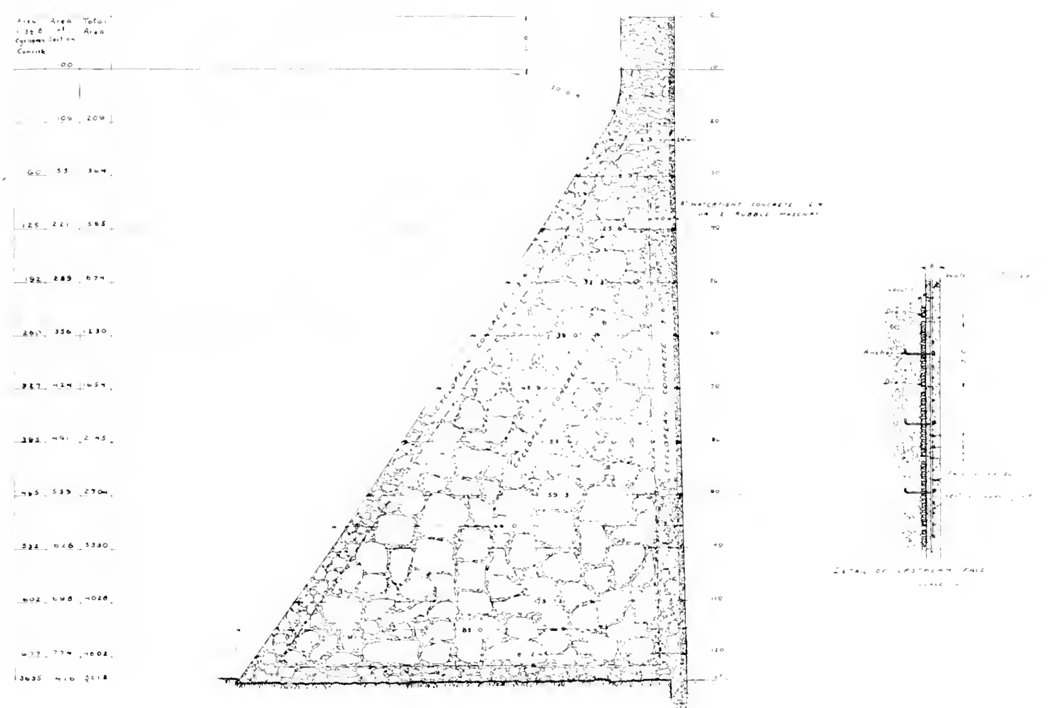

Fig. 1b. Standard Dam Profile No. 1

When calculating a dam we have always been accustomed to divide the profile into horizontal sections. Let us divide it into vertical sections for a change. (See Fig. 3.) With reservoir empty, the maximum pressure on the foundation for column A is the weight of this column. The safe height H is found from $145.H = 40{,}000$; $H = \frac{40{,}000}{145} = 276$ ft.

The weight of one cubic ft. of the concrete is taken as 145 lbs., and the allowable pressure per square ft. = 40,000, or 278 lbs. per square inch. The unit pressure on the foundation, due to the weight of B and C, will be less, so we need only consider the weight of A, and it is inconceivable how this weight could produce tension if H and l.

The up stream face can be made vertical to a height of 276 feet. The material saved in this way could be placed on the down stream face, thereby increasing the stability with reservoir full of water; that is the time we need a safe dam

A sheet of watertight concrete 8 inches thick can cheaply be reinforced sufficiently to prevent temperature cracks, providing this facing is not forced to take part in the expansions of the main body. The seepage through the sheet should be drained off to prevent accumulation of enough water to cause any considerable pressure back of facing with reservoir full. The pipes carrying this drainage water from the up stream face out through the toe could be of wrought iron, provided with valves, and these valves could be kept closed with reservoir less than three fourths full to save water in case the leakage should be considerable. For detail see Fig. 1b. For such construction, the cost of reinforcing steel would be \$29 per running foot for a dam 120 ft. high, with steel at 5 cents per lb. in place.

Having decided upon a vertical face to a height of 276 ft., or 1.50 slope, the calculation of the dam for reservoir full becomes very simple. Three or four formulae are ad that are

necessary [illegible] taken 10 ft., and the distance both faces may remain vertical is found from

$$d = a \sqrt{\ } \qquad (2)$$

where a = top width, r = specific gravity of material = $2\frac{1}{3}$

$$d = 10 \sqrt{2\tfrac{1}{3}} = 15.3 \text{ ft.}$$

Below this point the down stream face is sloped to keep the line of pressure reservoir full within the center third of the profile.

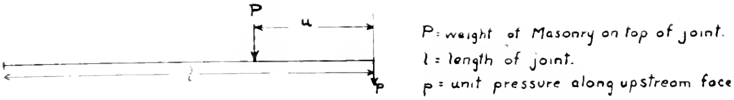

Fig 2

The length X of any horizontal section at 30' depth (d = 30) is found

$$X^2 \left(\frac{4w}{h} \cdot l\right) X = 6 (wm \cdot M) \quad l^2 \qquad (3)$$

See Figures 1 and 4 for values $M = \frac{d^3}{6r} \quad \frac{30^3}{6 \times 2\frac{1}{3}} \quad 1929$

$$X^2 \left(\frac{4 \cdot 153}{14.7} \quad 10\right) X \quad \frac{6}{14.7} (153 \quad 5 \cdot 1929) \cdot 100$$

$$X \quad 51.6\, X \quad 1200 \quad 0$$

$$X \quad 17.4 \text{ ft.}$$

$$\frac{M}{W} \quad \frac{1929}{346} = 5.57 \qquad (4)$$

[illegible] found [illegible] also [illegible]

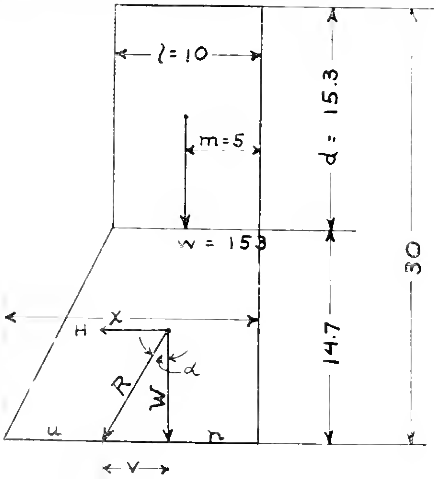

Fig. 4

[illegible] full [illegible] the factor of [illegible] With [illegible] of twice [illegible] $\frac{M}{W}$ [illegible] doubled, [illegible] reservoir full, [illegible] down stream face. During the travel of the center line of pressure between the middle third and the outside position, tension in the up stream face will commence; just when is difficult, perhaps impossible, to calculate. Maybe the compression can be distributed over a large enough area to keep the unit stress well below the elastic limit, in which case we would have no tension in the up stream face before the line of pressure fell outside the section.

To resist the horizontal thrust of the water we have the shearing strength of concrete and the friction.

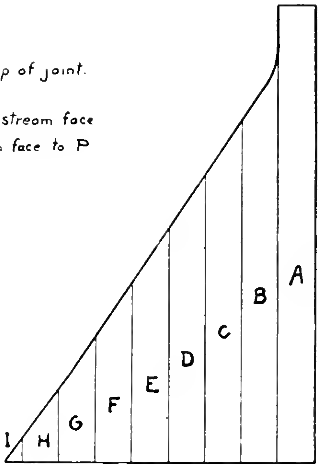

Fig. 3

[illegible] is

$$\frac{H}{W} \quad \tan \alpha$$ where a is taken 36° maximum; in other words,

$$\frac{H}{W} \quad 3.4$$

[illegible] strength of the concrete is generally neglected, [illegible] that it is an uncertain quantity. So [illegible] friction, and as the resistance the gravity section [illegible] against [illegible] or even at [illegible] very moderate stress is [illegible] the resistance it would offer against sliding, [illegible] factor is taken into consideration, the writer sees [illegible] it should be neglected.

[illegible] take the thickness of the dam 30 feet from [illegible] 17.4 feet as found above, and the width 1 foot. The [illegible] thrust of the water would be $\frac{d}{2r}$ [illegible] 193 · 145 [illegible] 28,000 [illegible] This would cause shear distributed over an area of 17.4 [illegible] 17.4 · 144 = 2505 square inches.

[illegible] stress = $\frac{28000}{2505}$ = 11.2 pounds per square inch.

[illegible] factor of safety would be between 10 and 20.

[illegible] friction coefficient f = $\frac{H}{W}$ = $\frac{193 \cdot 145}{346 \cdot 145}$ = 0.558.

[illegible] factor of safety for friction $\frac{0.75}{0.558}$ 134+.

[illegible] safe unit stress on the down-stream face was taken [illegible] 32,000 pounds per square foot, and when this is reached [illegible] length of the lower joints is found from

$$X = \frac{6\,M}{p} \text{ where } p = 32{,}000 \qquad (5)$$

So far the factor of safety of the dam against overturning has been found to be two or slightly more reservoir full. By introducing steel rods in the up-stream face and in the toe, this factor of safety can with but little extra cost be brought up to 4, the usual minimum generally employed in all other construction work.

(*Values for H and W taken from Figure 1.)

Taking a dam 120 feet high, the total horizontal water pressure per running foot length is 3084×145=447,180 pounds. (From column 3, Fig. 1.)

The moment of this pressure around any point in the foundation at 120 feet

$$447,180\times 40=17,897,200 \text{ foot-pounds.}$$

Rubble Masonry Dam.

The resisting moment of the section (see Figure 5) = As. fs. g^1 where As is the area of steel, fs the unit tensile stress in the steel and g^1 the moment arm of the couple. In this case with sufficient accuracy $g^1 = 0.85g = 0.85 \times 75 = 63.8$ ft.

The ultimate tensile strength of twisted steel is above 80,000 pounds per square inch, and the elastic limit is at about 55,000 pounds per square inch. The factor of safety need be only two. Therefore, fs can be taken at 40,000 pounds per square inch. At this high tension the concrete will help out the steel some.

Then, moment of water = As × 40,000 × 63.8 = 17,897,200

$$As = \frac{17,897,200}{63.8 \times 40{,}000} = 7 \text{ square inches}$$

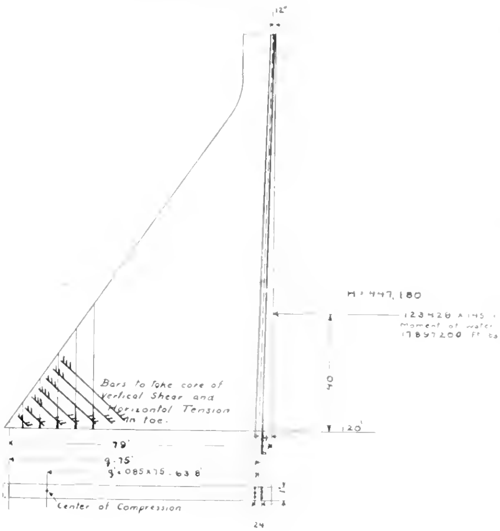

Fig 5

The section could be made up of 7-1 inch square rods and decreased towards the top corresponding to the decreasing load. For a dam reinforced in this way, floatation does not need to be considered, nor is the reinforced water-tight facing necessary. If steel is left out, the maximum tensile stress in the concrete will be

Bending Moment × Distance from neutral axis to outer tension fiber in concrete.

Moment of Inertia.

$$\frac{17,897,200 \times 39.5}{\frac{1}{12} \times 79^3} = \frac{706,939,400}{41086} = 17,200 \text{ lbs. per square}$$

ft. = 120 lbs. per square inch.

With this unit tension, the factor of safety will be about 1½. This shows that a concrete dam without steel reinforcing well made will stand up even should the line of pressure reservoir full fall clear outside the profile. The compressive stress in the down-stream face due to the bending moment should be added to the compressive stress due to the resultant of the weight of the dam and the horizontal component of the water pressure. The factor of safety of these combined stresses would in all cases be more than 4.

One point which has not yet been considered is the vertical shear, and the horizontal tension in down stream toe caused by the bending moment of the horizontal pressure of the water. These forces evidently are in existence, although they may not amount to much. How to make correct assumptions for their calculations the writer does not know, but suggests to put some reinforcing steel at random in the toe to take care of these stresses. This steel would also add to the strength of the concrete mass along the toe where the compression is the highest and the same unit stress as is used for the up-stream face could be used for the down stream face also.

The additional cost of reinforcing the dam as proposed will be about $95 per running foot for a 120-foot dam with twisted steel at 5 cents a pound in place. The contents per running foot of a dam 120 feet high with a profile as shown in Figure 1 is 178 yards. At $10 a yard in place, the cost is $1780 per running foot. Percentage cost to be added for steel

$$\frac{95 \times 100}{1780} = 5.33\%$$

With 5.33% added to the cost, we add 100% to the strength. It may be argued that the steel may rust out in 100 years, but if the concrete is properly put in, at the end of 100 years it should have nearly as much additional strength in itself as the steel and concrete together when it was first put in.

COPPER MARKET SITUATION.

The market for copper has been quieter lately, but it is natural to expect a slowing down in buying activity as the year end comes into close view. Consumption, however, and mill operations are progressing nicely. Manufacturers note a most substantial increase in business within the past month and a half, and most of the prominent establishments are now running full time. The demand for manufactured products developed rapidly last month, and we are getting nearer to normal conditions than at any time this year, and a trade revival along all lines is what competent observers are building upon.

So far as the local copper market itself is concerned, business is less active than a few weeks ago. The diminution in the volume of sales is not so surprising after the heavy buying in November, when manufacturers provided themselves freely with the necessary copper to fill the major part of their orders for from thirty to sixty days. Although recent purchases have been moderate, sellers generally maintain a firm grip on the market. While some irregularity in prices has prevailed owing to offerings of spot and December copper, we find it difficult to quote January and February electrolytic wirebars under 14½. In fact, it might be a hard matter to buy for the next two to three months much below 14½ in this market, although foreign buyers could probably do better than buyers here.

PRESSURE FLUCTUATIONS IN TURBINE PIPE LINES.*

By Prof. A. Budau, Engineer, Vienna, Austria.

The progress in utilization of water power frequently compels the engineer to transfer his work from the inhabited valleys to rough mountain regions where, of the two factors of hydraulic energy, viz., head and quantity of water, at least the former is available in abundance.

The utilization of water power with high head, however, offers some difficulties. To obtain a high head, most frequently a long ditch is required whose construction is made difficult by unfavorable topographical conditions and obstructions to transportation. Next to this, in most cases, comes a very long pipe line which forms a very disagreeable link in the complicated mechanism of a hydraulic power plant, because it not only means an increase of first cost of the plant, but also causes complications of operation.

Against freezing of the pipe, covering of same is only a scant protection. During the time of severe cold weather, water has to run through the pipes continuously; otherwise they will freeze, notwithstanding the covering; but even during the warm seasons a pipe line can cause difficulties if, as is always the case in these days, a very accurate speed regulation of the turbines is required.

The modern turbine governors open and close very rapidly. Ten years ago governors were not an exception which, in case of complete drop of load, happening, for instance, as a result of a short circuit in the electric net, shut the turbine off in twelve to thirteen seconds; but the time of closing has been continuously reduced, especially since the so-called hydraulic governors have been adopted, which have stored energy available, and today, a closing time of two seconds for turbines of many thousands of horsepower cannot yet be taken as the lowest limit.

It is impossible to rapidly stop the flow of a large quantity of water offhand, and certain precautions have to be taken. It goes without saying that these precautions have to be most careful and most complete if the water is conveyed to the turbine in a long pipe line.

The discussion of such devices, and some theoretical investigations referring to same which a practicing engineer, on account of the absence of any guiding material in literature, must carry out to satisfy the responsibility thrust upon him; further, some experiences with long pipe lines, will constitute the contents of this paper.

If a certain quantity of water Q flows through a pipe line of the cross section F, the water in this latter will obtain a certain velocity v which can be calculated from the formula $v = Q : F$, if the quantity Q of water is known which flows through the pipe in a second. If the water is conveyed through the pipe line to a turbine, and H is the head from the head water level to the distributor of the turbine, immediately in front of the turbine a water pressure will prevail which is equal to $H - \frac{v^2}{2g} - \frac{\xi v^2}{2g}$, wherein ξ represents the coefficient of the pipe friction and g the acceleration of gravity. If now, while the water is flowing, its discharge from the distributor is suddenly stopped, a great rise of pressure will take place, especially at the lower end of the pipe line, and unless the pipes are elastic, a rupture will necessarily follow.

The water flowing in the pipe with the velocity v contains energy [illegible] which cannot suddenly be destroyed and must [illegible] itself in deformation of the pipes. This [illegible] l [illegible] the length of the pipe line and F its [illegible] cross section, expressed [illegible]

$$L = F \cdot l \cdot \frac{\gamma}{g} \cdot \frac{v^2}{2} \qquad \text{I}$$

wherein γ [illegible]

* Translated from the German and partly revised by the author [illegible] Society [illegible] Pacific Coast [illegible] Association of Engineering Societies.

This rise of pressure, which, if occurring with considerable force, is feared in water mains as so-called hammer, one has endeavored to reduce in turbine pipe lines by installing at the lower end of the pipe line an air chamber (Fig. 4) or a standpipe B, also called free air pipe (Fig. 5), whereby the energy of the water flowing in the pipe line was to be given an outlet, compressing the air in the air chamber or lifting the water in the standpipe. Also safety valves have been applied.

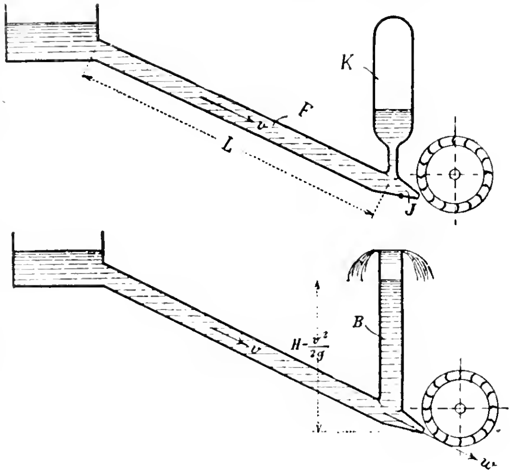

Fig. 4 and 5

There are, however, and especially in the most modern plants, by-passes or synchronous gates, devices which are operated simultaneously with the gate mechanism of the turbine so as to give to the water, which is held back when the turbine distributer is closed, an outlet into the tail water.

The writer advised such arrangements twelve years ago in a paper published in 1895 in the *Schweizerische Bauzeitung*. In the meantime, also, machines have been built where the non-utilized water passes through the distributer of the turbine, and such turbines, with combined distributer and free passage regulation, are designated as free passage turbines.

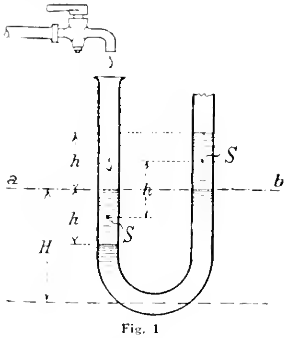

Fig. 1

Standpipes are used under heads up to 400 feet, and economically only then if the topographical conditions are otherwise favorable. Air chambers have been frequently installed in former years, nowadays, however, they are not used any longer. Under the high pressure the water absorbs the air which is above it, and continuous refilling with air by means of specially provided compressors was found necessary, which soon became cumbersome to the operators. One also hears, in some cases, that the governors operate better if the air chamber does not contain any air at all and is a water chamber only;

and that the shocks of the water are not so bad as to cause any damage to the pipe, etc.

This, indeed, is logically correct, and it can be easily proved that air chambers themselves can become the cause of increasing periodical oscillations of the speed governors.

In a U-shaped bent tube (Fig. 1), let water be up to height H, which, of course, is equal in both legs. By some cause the water is brought into oscillation, and it will rise above the line ab in either leg alternatively, and fall below H. These oscillations of the water level in the two legs of the tube will last quite awhile; in fact, they would not stop at all if there was no friction at the walls of the tube and between the particles of water themselves. The elevation of the center of gravity S of the water cylinder of the cross section F and the length h, or, in other words, the length h multiplied by the weight of the water cylinder, $F \times h \times \gamma$, gives the amount of energy which is contained in these oscillations and which also had to be contributed to the water to bring it into oscillation.

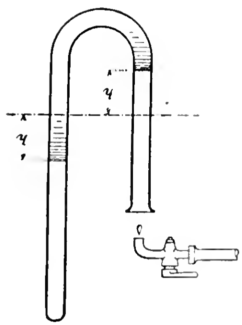

Fig. 2.

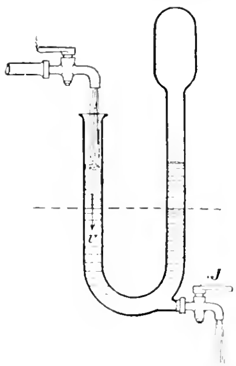

Fig. 3.

If now, while the water level is going down, a drop of water is allowed to fall into it, the height of oscillation h will be increased a small amount, and if frequently at the correct moment a drop falls upon the oscillating fluid, the oscillations of the water will increase until an overflow of water over the edge of the tube takes place.

The same will occur if one of the two legs of the tube is closed on top or if an air cushion is located above one of the water levels (Fig. 2), only in this case the oscillations h will be smaller and will only reach a certain maximum value, since the reaction upon the water level in the closed leg of the tube increases with increasing rise.

Also a moving water column can be brought into increasing oscillations by continuous small impulses if it is connected with an air chamber.

Through the left leg of the U-shaped tube (Fig. 3), water is supposed to flow with a velocity v, discharging through a cock J. If now this cock is suddenly closed, a rise of pressure takes place which will cause a compression of the volume of air in the right closed leg of the tube, and the fluid, the flow of which is stopped, will be brought into oscillation exactly as in the previous case. If the cock J is not entirely but only partially closed, this will also cause an impulse to oscillate. There will also be oscillations which will be smaller than if the cock had been closed entirely, but which will last until the impulses of the particles of fluid against each other, and especially against the ones newly entering in the left leg of the tube, and further, the friction of the water on the walls of the tube, have used up the respective amount of energy.

If, for instance, the cock is only half open and be closed a certain amount every time when the water in the right leg rises, and then opened again, the oscillations can be raised to a maximum amount, the analytical calculation of which is not simple; but it will occur if the cock is alternately entirely opened and entirely closed.

Considering a high-pressure turbine provided with air chamber and governor (Fig. 4), one can see immediately its analogy with the arrangement shown in Fig. 3. The regulating apparatus of the turbine has taken the place of the cock J in Fig. 3; the retardation of the flow in that moment at which the pressure rises, viz., when the water enters the air chamber K, is accomplished with the greatest accuracy by the speed governor. If, from any cause—for instance, on account of shutting of a by-pass in the pipe line—a rise of pressure occurs at its lower end, the governor of the turbine running under a constant load will be forced to somewhat reduce the amount of water entering the turbine; since the pressure rise, on account of the shutting, would have as a result an increased flow of water from the supply apparatus, therefore a larger amount of water supplied to the turbine; this would result in a speeding up of the turbine. The now following return wave will cause a drop in water pressure, the output of the turbine will be reduced, the governor will open and again close at the next pressure rise, and it can easily be seen that under these conditions the governor can increase the oscillations in the water column up to a certain maximum value.

Such experiences with air chambers have been had at many places, and it is surprising that so far nothing about them has gained publicity.

The above investigation also shows that the oscillations will decrease the quicker, the larger the amount of water flowing through the pipe line, because the newly entering water, on account of its inertia, will counteract the oscillations, and, therefore, is a very powerful factor in damping the water fluctuations.

This also explains the fact, which is very little known, that one can steady the governor which has become uneasy on account of water oscillations in the pipe line by opening a by pass and giving the water in the pipe line a higher velocity. Experience also shows that simultaneous oscillations of the governor and of the water in the pipe line more readily happen when turbines utilize small quantities of water, viz., in cases where the velocity of the water in the pipe line is low.

In this respect standpipes, which have been frequently used in America, are better than air chambers. At a sudden complete or partial closing of the supply apparatus of the turbine (Fig. 5), the water level of the standpipe B will rise on account of the rise of pressure, and part of the water Q' will overflow the edge of the standpipe. The energy of oscillation, as a result, will be decreased in accordance with the ratio $\frac{Q'}{Q-Q'}$ if Q represents the quantity of water flowing in the entire pipe line. The return wave must, therefore, be necessarily much smaller since the water at each following forward wave loses some of its energy on account of the water overflowing the edge of the standpipe. This circumstance, and the damping action of the water newly entering the pipe line, which changes energy of oscillation into eddies and friction, just as with air chambers, brings the oscillations very quickly to a stand-still, even if the speed governor has the tendency to increase same.

Similar to the standpipes act the safety valves; they must, however, be sufficiently large to discharge at each oscillation a sufficient amount of water to cause a decrease of the energy of oscillation, notwithstanding the disturbing influence of the governor.

Also pressure-regulating devices have been provided which, in case of an increased pressure of the water, open a by-pass to the tail water, as, for instance, spring balanced accumulators, where the plunger, in case of rise of pressure, moves upward and opens a by-pass. Such devices are better than air chambers because they take energy out of the water, and also better than standpipes, because they do not contain a great mass.

Any engineer who has to determine upon the dimensions of the pipe line is interested to know what increase in pressure will take place in the line if it is quickly closed, with a lower limit not to be exceeded, say two seconds, and if the water was flowing previously with maximum velocity corresponding to the turbines being totally open.

Increase of Pressure in a Pipe Line at Sudden Closing

An investigation as to what extent the pressure can rise in a pipe line if the latter is closed suddenly, so that the entire kinetic energy of the water flowing in the line has to be taken up by the elasticity of the pipe walls (used for doing work of deformation), gives a definite formula.

$$(h_0)=\sqrt{h_1^2+\frac{3S}{D}\,\frac{Ev^2}{\gamma g}}-h_1.$$

Where h_0 = increase in pressure, h_1 = head of water in feet, S = thickness of pipe walls in inches, B = diameter of pipe in inches, E = modulus of elasticity of pipe material, v = velocity of water in inches per sec., $\gamma = 62.408$ and $g = 32.153$.*

The specific strain K of the pipe walls is figured to $K=\frac{Dp}{2S}$, wherein p represents the specific pressure.

Example.

In a pipe line of 54 in. diameter, water flows with a velocity $v=6$ ft.; the lowest pipes of sheet steel are ¾ in. thick; the line is under a head of 200 ft. or a pressure of 86.8 lb. per sq. in. To what point will the pressure rise if the flow is stopped suddenly?

According to the formula:

$$h_0=\sqrt{200^2+3\,\frac{0.75}{54}\cdot\frac{28\,000\,000\cdot 144\cdot 36}{62.4\cdot 32.153}}-200$$

$$=\sqrt{40\,000+\frac{2.25}{54}\cdot\frac{4\,032\,000\,000\cdot 36}{108\,342.9}}-200$$

$$=\sqrt{3\,053\,432}-200$$

$$=1\,747-200=1\,547\text{ ft.}$$

The rise of pressure at the assumed, but in reality impossible, sudden closure will be over 1 500 ft., more than seven times p_1. The pipes would be strained

$$k=\frac{D}{2}\cdot\frac{p}{S}=27\cdot\frac{672}{0.75}=24\,192\text{ lb. per sq. in.},$$

which would exceed the elastic limit, but still leaves some safety against rupture. The normal strain of the pipe is:

$$k=\frac{D}{2}\cdot\frac{p}{S}=27\cdot\frac{86.8}{0.75}=\frac{2\,343.6}{0.75}=3\,124\text{ lb. per sq. in.}$$

If the pipe was only ⅜ in. thick it would be normally strained 6 248 lb. to the sq. in. At sudden closure the increase in pressure, however, would be less than with thick walls, because the thinner walls can give more.

For $S=\frac{3}{8}$ in.;

$$h_2=\sqrt{40\,000+\frac{1.125}{54}\cdot\frac{4\,032\,000\,000\cdot 36}{2\,006.35}}$$

$$=\sqrt{40\,000+1\,506\,716}$$

$$=\sqrt{1\,546\,716}=1\,243,$$

which is less than seven times h_1; there is further,

$$k=27\cdot\frac{540}{0.375}=38\,880,$$

not two times the value of 24 192 found above, as was to be expected with walls of half the thickness.

* For the mathematical development of this formula the reader is referred to the original paper.

The formula does not contain the length of the pipe line, which is quite evident; for each foot of length of the energy-carrying water there is a foot of length of energy-receiving pipe wall. This, of course, is correct only with the assumed sudden closure. It will be found in the following what tremendous influence the length of the line has upon the rise of pressure if the closure takes place in a certain determined time, say 2 to 6 seconds; of course, the values will be found smaller than with sudden closure.

Since the velocity v for turbine pipes will always have a maximum between 6 and 9 ft., the modulus of elasticity E for plate steel has a constant value, γ and g also are fixed values, the increase in pressure at sudden closure depends only upon the ratio between the thickness of the pipe and its diameter and upon the pressure to which the pipes are subjected. The example which was figured out above shows that under high heads an absolute safety at sudden closure can be obtained only by extraordinarily increasing the thickness of the pipe, which would considerably increase the cost of the line. It is, therefore, natural that with long pipe lines one introduces safety devices which at sudden closure prevent its rupture. Of course, one finds occasionally such safety devices where there is not the least danger for the pipe line. Such needless installations could happen only because on the subject treated herewith nothing has been furnished anywhere in the technical literature that is useful to the practicing engineer.

The energy taken up by the pipe walls is not destroyed, but the pipe walls will, after stationary conditions are reached again, contract to their original diameter and force back the surplus, but very small, quantity of water into the reservoir, which may be accompanied by some fluctuations back and forth. These conditions will be treated with the discussion of the standpipes.

Increase of Pressure with Definite Time of Closure

The closure of a line can never take place instantaneously; a certain time for moving the closing mechanism will always be required, which might sometimes be very short.

It is to be investigated what rise of pressure will take place at the lower end of a turbine line, if the governor closes the turbine within a certain time, called Closing Time, designated T.

Apparently in this case a moving column of water, whose length is always equal to the length of the pipe line, is first retarded in its motion by increasing the resistances at the section of the discharge and finally stopped entirely. Herewith this column of water causes a shock against the closing apparatus, which is felt in the fluid as an increase in pressure, and, on account of the incompressibility of the water, is transmitted backwards towards the entrance section with decreasing intensity. For determining approximately the greatest increase in pressure, it is sufficient to apply the law of impact, in which the energy contained in the water during the discharge is not deducted, however. It may also be mentioned again that the problem dealt with is a problem of undulation.

One finally finds for the maximum rise for a certain time of closure T,

$$(h)=\frac{\sqrt{h_1^2+3\frac{S}{D}\,\frac{Fv^2}{\gamma g}}-h_1}{\frac{T}{T_2(h_2)}\sqrt{\left(h_1^2+3\frac{S}{D}\,\frac{Fv^2}{\gamma g}\right)}+1-\frac{h_2}{(h_2)}\,\frac{T}{T_2}}$$

where h represents the pressure prevailing at the beginning of the closure. (This is an empirical formula which is developed in full by the author.)

(To be continued.)

UNNECESSARY LOSSES IN FIRING FUEL OIL.*

By C. R. Weymouth.

Practically all oil-fired boiler plants in stationary practice are subject to hand control throughout. It is customary to maintain a uniform oil pressure at the oil pump and in the oil-pressure main, and to throttle the supply of oil by hand at all of the individual burners. It is also customary to operate with full boiler steam pressure on the main supplying steam to all the burners, and to regulate by hand the supply of steam for atomizing purposes, at each of the individual burners. Boiler dampers also are all subject to hand control on the individual boilers.

In a central station having, say, twenty 500-horsepower boilers, there would be about 60 burners. For economy of labor, there would probably be not more than two or three firemen to the shift, in a plant of this size. On a commercial railway or lighting load subject to the usual fluctuations, such a plant would probably be operated with the rear boiler dampers clamped in fixed positions, wide open or nearly so. The supply of steam to burners would receive little attention, but the supply of oil to the burners would be regulated for variations in load by throttling to the extent necessary for maintaining the desired steam pressure. In such a plant there would be a more or less uneven rate of firing at the various boilers, and an excess of air for combustion at all loads, particularly at the lighter ones corresponding to a nearly uniform rate of flow of air through the furnace. The operators are likely to become careless, not noticing the drop in steam pressure with a sudden increase in load until this has become considerable, necessitating a severe momentary rate of firing in a number of boilers to bring the steam pressure back to the normal. This severe duty increases the expense for repairs to the boiler settings, rate of burning out of tubes, etc.

In certain plants where engineers are enlightened as to the principles of combustion, the attempt is frequently made to operate on a reduced air supply, with the result, if the dampers are set for mean or nominal load, that the chimneys smoke excessively on overloads before the limited number of firemen can reach all the dampers to open them.

As the lamentable result of these conditions, the average boiler plant efficiency with crude oil, even with the best types of boilers, averages much nearer 70 than 80 per cent, which is possible in large plants under proper methods of control.

Probably it will always be impossible to instill into the mind of an ordinary fireman such knowledge of the principles of combustion and the losses due to excess air supply as to obtain economical results in large stations where it is necessary to depend on hand firing. Improved conditions can be secured by the employment of a boiler room engineer whose duty it is to scrutinize all fires from time to time and to coach the firemen in their duties; but the only ideal method seems to be an automatic system of control, such as will be here described, where the various adjustments, having once been made for economical conditions, are automatically repeated for the various conditions of load, maintaining a high average economy from month to month. With well-designed oil furnaces and careful adjustment under uniform load conditions, carefully conducted tests have shown that it is possible to obtain high percentages of CO_2, indicating as low as 10 per cent excess air over the requirements for perfect combustion, with no unconsumed elements in the flue gases.

Numerous data relating to coal fuel are available, showing the importance of reduced air supply as tending to high furnace efficiency; also the relation of excess air supply to any observed percentage of CO_2 and other factors of gas analysis. As few data for oil fuel are available, the following will be presented.

All Pacific Coast crude oils contain a certain amount of moisture, sulphur, nitrogen, and oxygen; the main constituents being carbon and hydrogen. The characteristic difference in oils of different gravities lies in the relative quantities of carbon and hydrogen contained, there being more carbon and less hydrogen in the heavier oils, less carbon and more hydrogen in the lighter. In the better grades of oils treated at the wells before shipment, in which moisture has been largely eliminated, it can be roughly assumed that 3 per cent of the oil is made up of sulphur, nitrogen, oxygen, and water. This relation-ship is not universal, certain Southern California oils containing a large percentage of sulphur.

The predominating oil used on the Pacific Coast, known as Bakersfield oil, averages about 16 deg. Baume, which is equivalent to 336 pounds of oil per 42-gallon barrel. The ultimate analysis of this oil is about as follows:

Carbon, 85 per cent.
Hydrogen, 12 per cent.
Sulphur, 0.8 per cent.
Nitrogen, 0.2 per cent.
Oxygen, 1 per cent.
Water, 1 per cent.

A number of lighter oils in general use, ranging in the neighborhood of 18 to 20 deg. Baume, would average about as follows:

Carbon, 84 per cent.
Hydrogen, 13 per cent.
Sulphur, 0.8 per cent.
Nitrogen, 0.2 per cent.
Oxygen, 1 per cent.
Water, 1 per cent.

Certain heavier oils ranging from 12 to 14 deg. Baume average about as follows:

Carbon, 86 per cent.
Hydrogen, 11 per cent.
Sulphur, 0.8 per cent.
Nitrogen, 0.2 per cent.
Oxygen, 1 per cent.
Water, 1 per cent.

As a result of tests by Edmond O'Neill, professor of chemistry of the University of California, the calorific value of Bakersfield oil may be taken as about 18,600 British thermal units per pound, allowing for the presence of about 1 per cent moisture as indicated above. When corrected for moisture, the net heat units per pound of oil are proportionally higher, although there is a slight loss in furnace efficiency due to the presence of moisture, inasmuch as all such water is evaporated into steam and superheated to the temperature of the escaping gases, involving an amount of heat both sensible and latent.

On the basis of the above analyses, the chemical requirements of air for complete combustion per pound of oil are as shown in Table I.

In the various text books, the values given range from 16 to 18 pounds of air per pound of oil, but an average of 14 pounds of air per pound of oil is more nearly correct.

The ordinary method of indicating and measuring steam to atomize oil has been to express the quantity as a percentage of the actual amount of water evaporated in the boiler. This percentage ranges from about 2 to 5 and over, depending on the system of oil burning, type of burner, etc. While such a percentage rating is no doubt convenient, it is inaccurate, in that the steam consumption of oil burners is proportional to the oil burned and not to the water evaporated. Various tests have shown that the steam consumption of oil burners ranges from 0.14 to over 0.5 pound of steam per pound of oil. The average value of good performance is about 0.3 pound of steam per pound of oil, although with hand regulation on variable load this quantity should be slightly increased, and is somewhat dependent on the gravity of the oil, temperature at the burners, etc. In stationary practice, the use of air for atomizing purposes has been practically abandoned.

* Presented at the annual meeting (December, 1908) of the American Society of Mechanical Engineers.

TABLE 1. WEIGHT OF AIR REQUIRED FOR COMBUSTION OF OIL OF DIFFERENT GRADES.

Grade of Oil	Light	Medium	Heavy
Per cent of C	84.00	85.00	86.00
Per cent of H	13.00	12.00	11.00
Per cent of S	0.80	0.80	0.80
Per cent of N	0.20	0.20	0.20
Per cent of O	1.00	1.00	1.00
Per cent of H_2O	1.00	1.00	1.00
Calculated air per pound of oil chemically required—pounds	14.25	14.02	13.79
Corresponding maximum per cent CO_2 by volume—dry gases of combustion, per cent	15.16	15.52	15.89

As no direct experiments have been made showing the loss in boiler efficiency due to various percentages of excess air supply, the writer will present some simple calculations showing the amount of this loss.

It is well known that the loss due to an excess of air supply is not only on account of the direct loss in heating the added air to the temperature of the flue gases, but there is a secondary loss due to the fact that, corresponding to an excess of air, there results a higher flue temperature not only for the actual amount of air necessary for combustion, but for all such excess air. Calculations as to boiler performance are simplified with oil fuel, as practically complete combustion is secured in a well-designed furnace, the carbon and carbon monoxide usually being burned to CO_2. The stack losses include the sensible heat contained in the dry gases of combustion, the sensible and latent heat in the steam from the combustion of hydrogen and oxygen and in the steam introduced through the burner, and the moisture present in air for combustion.

Assuming complete combustion, and employing a boiler radiation loss of 3 per cent, the writer has calculated the boiler efficiency, at rating, for various percentages of excess air supply, as given in Table 2.

TABLE 2. BOILER EFFICIENCY FOR EXCESS AIR SUPPLY.

Excess air supply, per cent	10	50	75	100	150	200
Assumed temperature escaping gases, deg. fahr.	400	450	475	490	Over 500	Over 500
Corresponding ideal efficiency of boiler per cent	84.2	80.27	77.66	75.22	Under 70.94	Under 67.09
Possible saving in fuel due to reduction of air supply to 10 per cent excess, expressed as per cent of oil actually burned under assumed conditions	0	4.67	7.78	10.68	Over 15.76	Over 20.32

The 3 per cent used for boiler radiation is subject to some variation, being greater in small boilers and less in large units. For medium units, 3 per cent is probably very close.

The stack temperatures for any particular type of boiler, for any given load and corresponding to any assumed per cent of excess air, will vary with the size of boiler, arrangement of heating surface, character of baffling, condition of heating surface, etc. Stack temperatures will also vary with the different types of boilers corresponding to these factors. The temperatures given corresponding to the stated air supply, from 10 to 100 per cent excess, are those to be expected in ordinary practice and necessarily approximate; with boilers having three passes of gases and superheaters, the temperatures in general will be lower than those indicated; with boilers having but one pass and flow of gases parallel to tubes, the temperatures in general will be higher than indicated.

Very few data are available for the temperatures corresponding to 150 and 200 per cent excess air, and the corresponding figures are given merely to show in a general way the magnitude of the losses easily resulting from careless firing of crude oil. The stack temperatures assumed are also subject to variation dependent on the rate of forcing the boiler and other well-known elementary factors. The excess air with careless oil burning is usually greater than with careless coal firing, because of the greater excess draft power of chimneys. In the preceding table, the writer has calculated the saving that could be effected by reducing the air supply from that specified to an ideal condition assumed to correspond to 10 per cent excess air. This saving in fuel is of vast importance, but has been almost completely neglected with oil fuel.

It is possible to obtain a fair notion of the percentage of excess air from a mere determination of the amount of CO_2,—that is, assuming all hydrogen having been burned to H_2O and all carbon to CO_2. Any simple formula involving the element CO_2 must be dependent on an assumed percentage of hydrogen in the oil fuel, but inasmuch as the hydrogen contained is fairly uniform for any given grade of oil, there is but little error in such an assumption.

TABLE 3. POUNDS OF AIR PER POUND OF OIL AND RATIO OF AIR SUPPLIED TO THAT CHEMICALLY REQUIRED.

Per cent CO_2 by volume as shown by analysis dry chimney gases	LIGHT OIL C, 84 per cent, H, 13, S, 0.8, N, 0.2, O, 1, H_2O, 1		MEDIUM OIL C, 85 per cent, H, 12, S, 0.8, N, 0.2, O, 1, H_2O, 1		HEAVY OIL C, 86 per cent, H, 11; S, 0.8, N, 0.2, O, 1, H_2O, 1	
	Pounds of air per lb. oil	Ratio air supply to chemical requirements	Pounds of air per lb. oil	Ratio air supply to chemical requirements	Pounds of air per lb. oil	Ratio air supply to chemical requirements
4	51.40	3.607	51.93	3.704	52.45	3.803
5	41.31	2.899	41.71	2.975	42.12	3.054
6	34.58	2.427	34.90	2.490	35.23	2.554
7	29.77	2.089	30.04	2.143	30.31	2.198
8	26.17	1.836	26.39	1.883	26.62	1.930
9	23.37	1.640	23.56	1.680	23.75	1.722
10	21.12	1.482	21.29	1.518	21.45	1.555
11	19.83	1.391	19.43	1.386	19.58	1.419
12	17.76	1.246	17.88	1.276	18.01	1.306
13	16.46	1.155	16.57	1.182	16.69	1.210
14	15.36	1.078	15.45	1.102	15.55	1.127
15	14.39	1.010	14.48	1.033	14.57	1.056

Table 3 shows the calculated weight of air per pound of oil and the ratio of actual air supply to chemical requirements, for the various grades of oil and various percentages of CO_2. Under the present systems of firing, the amount of CO_2 present in the flue gases is often as low as 4 or 5 per cent. With an ample supply of labor and a careful and scientific adjustment of dampers by hand, the percentage of CO_2 under an ideal and uniform load can be maintained as high as 13 per cent. With automatic control and under variable load conditions, it has been found possible to maintain a high percentage of CO_2 conforming very closely to ideal conditions.

A JOVIAN CORRECTION.

At the sixth annual meeting of the Rejuvenated Sons of Jove, held in Buffalo, N. Y., Mr. Alex Henderson, of New York City, offered a resolution that at the close of each annual meeting the assembled Jovians drink a standing toast to the First Jupiter, Chas. W. Hobson, No. 1, of Dallas, Texas, to the following sentiment:

"A single rose leaf passed before a man while he is alive is productive of more happiness and joy than a mountain of flowers heaped upon his grave."

In the account of the proceedings of that meeting, prepared for and published by the electrical press of the country, the beautiful sentiment, given above, unfortunately, was quoted incorrectly, entirely robbing it of its delicate fragrance. In justice to Mr. Henderson, and in justice to the sentiment itself, we publish the correct quotation, at the request of the writer of the original article.

CURRENT COMMENT

Sileo-vanadium steel is now used in making transformers, as on account of its improved magnetic quantity it decreases the core loss.

Electric traction in Great Britain is used solely on 216¼ miles and partly on 182 miles of road. There are 86 electric locomotives, 806 motor cars and 1,275 trailers in use on these railways.

Electric lighting on the Canal Zone has been completed between La Boca and Gorgona, thus giving light to every village and hamlet on the line. A 400 k.w. generator added to the equipment of the Empire power plant supplies current for the 1,185 lamps which have been added.

Electrification of the Ouest Railway lines entering the Saint Lazare Station in Paris is to be started. High tension three-phase current is to be transmitted by underground cables to transformer stations along the lines from Paris to Saint Germain and Argenteuil. Current at 650 volts is to be supplied by a third rail system.

Ohm's law fails when ionized gases are conducting electric current. If the distance between the terminal plates is halved, only half the number of ions will be [illegible] and the current will be halved instead of doubled. Up to the point of saturation the current is directly proportional to the voltage, but above this point there is no further increase in current.

Electrical banks are being formed in Germany to finance electrical undertakings. Money will be advanced to large or prospective users of electric light and power so that they can make improvements or carry out new [illegible]. Repayment is to be made in the form of annuities. [illegible] concerned in this are the [illegible] Siemens & Halske Co., and the Felton & Guilleaume [illegible] Co.

The tax on electricity and gas in Italy [illegible] since 1895. There is no tax on the [illegible] electricity [illegible] for industrial purposes nor for public lighting of streets and squares, nor for any other purpose except private lighting and heating. No tax is charged on heating for industrial purposes. The tax amounts to 0.4 cent per cubic meter of illuminating gas made from coal, 1.6 cents per cubic meter of illuminating gas made from mineral oil, and 1.2 cents for each kilowatt-hour of electrical energy.

Creosoted ties are to be used for the main [illegible] of the Pennsylvania Railroad. A tie treating plant is being [illegible] at Mt. Union, Pa., and two large creosote storage tanks are to be located at Greenwich Point, Philadelphia, Pa. The Mt. Union plant will be the first creosoting operation undertaken on a large scale by an Eastern railroad. It is estimated that proper treatment will increase the life of cross ties from two to three fold. Applied to all of the 100,000,000 ties which American railroads use annually, it would greatly reduce the drain on the rapidly-decreasing timber resources. The Pennsylvania Railroad alone uses from 3,500,000 to 4,000,000 ties each year. The average life of the red oak and chestnut ties under present conditions is from three to four years, while white oak lasts from seven to eight years.

The turbinal tubeless boiler is made of concentric annular conical vessels with narrow water spaces and narrow flame spaces, heated by a liquid fuel burner from below. The steam produced in the boiler proper descends through a helically-coiled superheater tube placed in the middle space of the innermost cone. The issuing steam is dried and comes out at a high temperature, something that may be over 600° F. It might have been anticipated that with such narrow water spaces all the water would have passed off as foam or priming, but somehow the boiler, when at work, appears to resolve itself into one of the semi-flash variety, and works well.

A human storage battery is the latest example of humorous "newspaper science." "A seven-year-old Russian boy has been discovered to be a human storage battery of electricity," says the New York American. "His strange powers were accidentally discovered by a metal filling which had been put in one tooth. The boy picked up the disconnected porcelain knob that was used to connect an electric fan with an electric light wire and thrust it into his mouth. As the metal cap touched the metal tooth filling the fan began to revolve and then to buzz at full speed. A thirty-two-candlepower bulb was attached to the end of the wire and the light burned brilliantly. When a steel thimble was put on the boy's finger and he grasped the end of the wires in his hand the same result was obtained. A piece of iron held in the boy's hand for a few moments becomes highly magnetized. A hammer with an iron handle held in his hands will attract tacks at a distance of four feet. Placed on a glass-legged stool, any one touching him received a distinct shock. An ordinary flat iron held in his hands for five minutes and then passed over tenpenny nails driven into hard wood pulled them with ease!!!"

A tax on electricity and gas is proposed in a bill just introduced in the German Reichstag. It is proposed to levy a tax of five per cent on the selling price of electric current, with a maximum of 0.4 pfennig per kilowatt-hour. Current generated for private use is to bear a tax of 0.4 pfennig per kilowatt hour, with a reduction to five per cent of the cost of production, when it can be proven that the above rate is in excess of this percentage. Gas is to bear the same rate of taxation per cubic meter of gas sold as the kilowatt-hour of electricity. Electrical installations of not over one and one half kilowatts capacity are to be exempt from taxation. If the product is imported from a foreign country, the receiver is to pay the tax; if it is exported, the exporter is to pay the tax. All electrical illuminants, as well as incandescent bodies for gas, alcohol and oil lamps, are also to bear their burden of taxation.

Coal gas in the United States in 1907, as reported by the 516 companies that made returns to the United States Geological Survey, was 58,096,478,402 cubic feet. Of this product 3,399,680,509 cubic feet were lost through leakage, fire, or otherwise and were reported as unaccounted for. The net product sold, therefore, amounted to 54,696,797,893 cubic feet, which was valued at $36,327,879, or an average of 66 cents per thousand cubic feet. Statistics of this product for 1906 were not published by the Survey, but those for 1905 show that the total quantity of gas sold in that year was 40,454,215,132 cubic feet, valued at $32,937,456, an average of 81.4 cents per thousand cubic feet, so that while the quantity of gas sold increased 14,242,582,761 cubic feet, or 35 per cent, from 1905 to 1907, the value increased only $3,390,423, or 10 per cent, and the average price per thousand cubic feet showed a decline of 15.4 cents. This apparent decline in value is attributed chiefly to the greatly increased production of by-product oven gas, most of which is used for fuel and all of which is sold at first hand at much lower rates than those obtained for gas produced as a primary product of gas works.

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CONTENTS

Quantitative Pressure Determinations

There is said to be nothing more changeable than the whim of a woman. One exception, perhaps, is the load carried by a great hydroelectric plant that supplies the heterogeneous light and power needs of several communities. For the satisfactory operation of such water wheels, under the many changes of load to which they are subject in electric service, several methods have been devised. In addition to the storage of energy in the fly wheel or battery, there are excellent governors on the market which accomplish this result.

While differing much in individual detail, these governors all have one point in common—their purpose is to vary the amount of water delivered to the wheels, thereby keeping constant the speed, which would otherwise vary with the load. This variation in speed is the cause of the annoying fluctuations in the brightness of an incandescent light, and to it the unsatisfactory operation of motors is often due. The desired uniformity of speed is attained at the cost of either much wasted water or of great strain induced by pressure in the system. As water is often scarce, this waste is undesirable, and consequently the problem is met as far as possible by pressure regulation. This regulating function of the mechanical governor, by the way, is analogous in many respects to the governmental regulation of corporations, which is now causing so much discussion.

Like any energy that is misdirected, this resultant pressure is capable of doing great damage. It is not practical to build pipe lines which are substantial enough to resist the enormous pressure that results when hundreds of tons of water flowing at high speed are abruptly arrested. The familiar water hammer is the audible expression of such sudden stoppages, which produce a wave similar to the vibrating sound wave in an organ pipe. This oscillatory wave may even become cumulative, with consequent pressure increase great enough to destroy the strongest construction.

Gradual stoppage by means of special gates reduces the pressure considerably, and together with some relief vent has made possible the successful operation of hydraulically driven generators, with economy of water and minimum of shock under variable load. These relief vents include air chambers, standpipes, safety valves, and by-passes, either singly or in conjunction.

These conditions thus briefly outlined are familiar to every hydraulic engineer, and in many cases the problems arising in connection with them have been satisfactorily solved, usually by the method of "cut and try." The knowledge has been qualitative rather than quantitative. Therefore the formulae and description as to what actually takes place in a pipe line as shown by PROF. A. BUDAU in this issue are of the greatest value.

PERSONAL.

John Llewellyn, of the Western Elevator Company, Los Angeles, is making a New Year's visit in San Francisco.

Harry J. Jastro has been appointed manager of the Bakersfield Power, Transit & Light Co., of Bakersfield, California, succeeding the late James Goodwin.

Harry K. Fish, Los Angeles representative of the General Electric Company, is in San Francisco to attend the annual sales conference of his company, which is being held here.

J. H. Lane, chief operator of the La Grange Water & Power Company, La Grange, Stanislaus County, California, was in San Francisco last week.

Ralph L. Phelps, of the San Francisco office of the Safety Insulated Wire and Cable Company, returned from a brief visit to Los Angeles on Wednesday of this week.

F. H. Poss, Pacific Coast representative of the Benjamin Electric Mfg. Co., and of the Holophane Co., Honolulu, expects to sail for Honolulu on January 9th.

Robert Howes, electrical engineer, formerly American Bank Building, Seattle, is engaged in consulting work for the British Columbia Electric Railway Company, and for the next few months will make his headquarters in Vancouver, B. C.

Gifford Pinchot, Forester, is making a trip to Mexico and Canada, bearing invitations from President Roosevelt to President Diaz, of Mexico, and Premier Laurier and Lord Gray, of Canada, to appoint delegates to the National Conservation Conference, to be held in Washington on February 18th.

F. N. Boyer, of Chicago, accompanied by Mrs. Boyer, who has been spending a few days in San Francisco, left for Honolulu on the steamer Korea, on December 22d. Mr. Boyer is in charge of the supply department of the General Electric Company at Chicago, and has been spending some months on the Pacific Coast, recuperating from the effects of severe work during the past year or two. Mr. and Mrs. Boyer expect to return from Honolulu some time in March, 1909.

Walter J. Jones, who has been associated for the past three years with the late Dr. F. A. C. Perrine, will continue the consulting engineering business of Dr. Perrine at the old offices, 10 Wall Street, New York City. Mr. Jones is carrying through to completion the work that Dr. Perrine had on hand at the time of his death, including work for the Bishop Creek Gold Company for a power plant, stamp mill, and hydraulic mining installation for the British Guiana Gold Company. He is consulting engineer for the United States Roller Bearing Company, and for the Interstate Railway Company. For the latter he is building a power plant of 10,000 kilowatts at Reading, Pa. This will involve the building of the power plant and changing of the present steam plant into a main synchronous converter sub-station from which will be operated the street railway system, low tension lighting and power system, and street arc lamps of Reading. There will also be installed four or five other sub-stations in the vicinity of Reading, to supply the inter-urban trolley systems. The plants include the re-equipment of the ... power plant, which is located about six miles from Reading.

TRADE CATALOGUES.

Electrical Equipment for Textile Mills is the subject of Bulletin No. 5910-10 from the Western Electric Co. It illustrates some interesting applications of electric drive.

"Fan Motors for 1909" is the subject of a catalogue just issued by the General Electric Company. This catalogue contains illustrations, descriptive matter and prices of the entire line of General Electric fan motors for the coming season. This line embraces motors for both alternating and direct current, in desk, bracket, ceiling, floor column and counter column types of standard sizes. It lists, also, ventilating motors and miscellaneous small power motors for alternating and direct current, as well as various supply parts of the standard fan motors. The catalogue, No. 4632, is attractively printed in colors, and will be furnished on application to the nearest sales office, or to the Publication Bureau, Schenectady, N. Y.

TRADE NOTE.

The Phoenix Glass Company, of New York, Pittsburg and Chicago, has retained the Bureau of Illuminating Engineering, 437 Fifth Avenue, New York, to act as consulting and designing illuminating engineers, in the matter of designing or re-designing glass globes and reflectors, as manufactured by them. Mr. Albert J. Marshall, chief engineer of the Bureau, will have direct supervision of this work.

The Aylsworth Agencies Company have moved their offices from New Montgomery and Minna Streets to rooms 405-6 Atlas Building, 604 Mission Street, San Francisco. They represent the following companies: Alphaduct Co., Jersey City, N. J.; Electric Goods Manufacturing Company, Boston, Mass.; Francis Keil & Son, New York, N. Y.; Apple Electric Company, Dayton, Ohio; Monarch Telephone Manufacturing Company, Chicago, Ill.; American Conduit Manufacturing Company, Pittsburg, Pa.; American Electric Fuse Co., Muskegon, Mich.; The Electro-Ad Company, Detroit, Mich.; Standard Electric Time Company, Waterbury, Conn.; and Chicago Coil Company. F. H. Parrish has recently acquired an interest.

CHRISTMAS TREE CUSTOM UPHELD.

The country's forests again have been called upon to supply about four million Christmas trees, and again many persons have asked themselves and have queried the United States Forest Service, "Is the custom a menace to the movement for forest preservation?"

In the millions of happy homes over the country where the younger generation has made the Christmas tree the center of play since early Friday morning, there are many mothers and fathers who have given the question more or less thought. From Sunday Schools and other organizations also, which hold an annual celebration around a gayly-trimmed evergreen for the benefit of the little ones, has come the question whether it is consistent to urge conservation of forest resources and then to cut millions of young trees every year to afford a little joy in the passing holiday season.

"Yes, it is consistent and proper that the custom should be maintained," has been the answer of United States Forester Gifford Pinchot in every case. "Trees are for use, and there is no other use to which they could be put which would contribute so much to the joy of man as their use by the children on this one great holiday of the year.

"The number of trees cut for this use each year is utterly insignificant when compared to the consumption for other purposes for which timber is demanded. Not more than four million Christmas trees are used each year, one in every fourth family. If planted four feet apart they could be grown on less than 1,500 acres. This clearing of an area equal to a good sized farm each Christmas should not be a subject of much worry, when it is remembered that for lumber alone it is necessary to take timber from an area of more than 100,000 acres every day of the year.

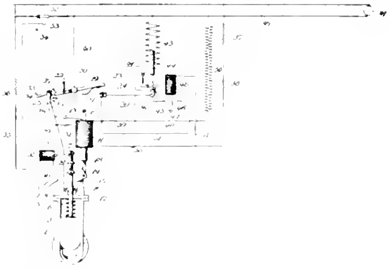
"It is true that there has been serious damage to forest growth in the cutting of Christmas trees in various sections of the country, particularly in the Adirondacks and parts of New England, but in these very sections the damage through the cutting of young evergreens for use at Christmas is infinitesimal when compared with the loss of forest resources through fires and careless methods of lumbering. The proper remedy is not to stop using trees, but to adopt wiser methods of use.

"It is generally realized that a certain proportion of land must always be used for forest growth, just as for other crops. Christmas trees are one form of this crop. There is no more reason for an outcry against using land to grow Christmas trees than to grow flowers."

PATENTS

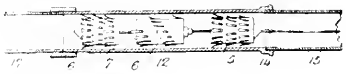
ELECTRIC WATER-VALVE. 906,509. George P. Carroll, Bridgeport, Conn.

In combination a casing having a port, means adapted to open or close port, automatic means for opening port by the application of electric power to former means when such power



is also applied for other purposes and for closing port through former means when the electric power is turned off from being used for other purposes, and automatic means operative when the power used for other purposes exceeds a predetermined limit to further open port.

ART OF CLEANING PIPE LINES. 906,595. George E. Whitney, South Orange, N. J., assignor to National Water Main Cleaning Company, New York.



The combination of a pipe provided with a sleeve on one end and a cleaning device located within the pipe, pipe being adapted to be inserted into and form a portion of a pipe line or main.

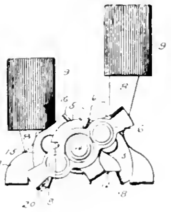
ELECTRIC FURNACE. 906,682. Kristian Birkeland, Christiania, Norway.

In an electric furnace for the treatment of gases having

[illegible] greater than that permitting [illegible] formation and restarting of the arc between [illegible] distort this arc into a helix.

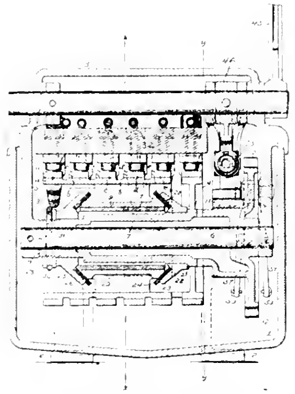
PUSH BUTTON ELECTRIC SWITCH. 905,740. Johann G. Peterson, Hartford, Conn., assignor to The Arrow Electric Company, Hartford, Conn.

A push button switch mechanism having a supporting plate, a spindle supported by plate, a lock plate mounted upon spindle, levers pivoted on the supporting plate and adapted to engage the lock plate, a spring carried by the supporting plate and engaging the lower ends of the locking levers and adapted to hold the upper ends of levers in engagement with the lock plate, a



yoke mounted on the spindle, push buttons connected with the yoke, an actuating spring with its ends engaging lugs projecting from the yoke and the lock plate, and feet projecting from the lower ends of the locking levers into the path of the tips of the push button shanks whereby the levers are disengaged from the lock plate when the spring is under sufficient tension, by the engagement of the tips of the push button shanks with the feet, substantially as specified.

ELECTRIC CONTROLLER. 906,576. Clarence L. Taylor, Alliance, Ohio, assignor to The Morgan Engineering Company, Alliance, Ohio.



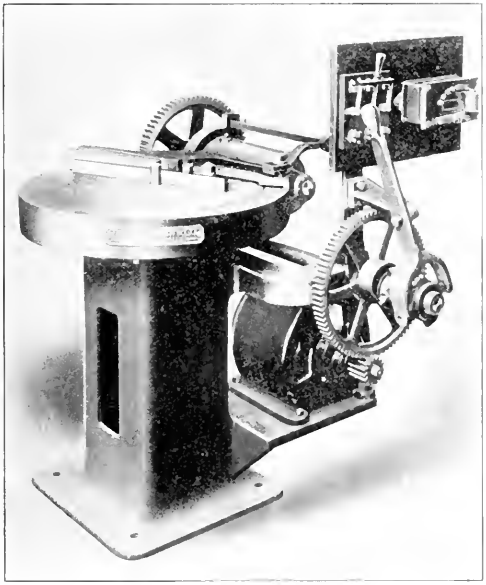
In an electric controller, the combination with a casing adapted to contain oil, and a cover having hinged connection with said casing, of a contact drum, contact fingers, and operating mechanism, all supported by and removable with hinged cover.

INDUSTRIAL

A NEW BENDING TESTING MACHINE.

The Olsen special testing machine shown in the accompanying illustration is designed for the "cold bend" testing of iron and steel specimens. The "cold bend" test is today specified by a great many manufacturers for a great deal of iron and steel, and the use of this machine greatly facilitates the process.

By the method heretofore used, bending tools were inserted in an ordinary tension testing machine. This required considerable time for setting the machine, which could be more profitably used for tension testing alone.



A New Bending Testing Machine

With this machine it requires only three minutes to bend a specimen double, that is, 180 degrees around a pin. The saving of time by the use of this machine for this special purpose in place of the old type of machine, is of great advantage to a steel mill or other establishment, where a great many tests must be made in a short time.

The machine is intended for making a "cold bend" test on iron or steel specimens up to a size of one inch square or equivalent. The specimen is bent around a pin of a diameter equal to its own thickness. Any size of pin up to two inches in diameter may be used, the smaller sizes being reinforced to withstand the bending pressure. The pins have taper shanks so that they can readily be changed to suit the different sizes of specimens. In order to insure ready release from the taper fit, a knockout pin is provided, which, when tapped with a hammer, releases the bending pin. Provision is made for placing the bending pin at varying distances from the center as required. A taper liner at the back of the specimen serves for the adjustment of the various sizes of specimens to be tested.

The outer circular edge of the machine is graduated for every five degrees, so that the specimen may be bent to any desired angle up to a complete bend of 180 degrees.

A small Westinghouse electric motor is mounted on a bracket at the rear of the outfit, so that the entire unit may be located wherever desired to give the greatest convenience of access. The motor is known as a type "R" direct current, $1\frac{1}{4}$ horsepower, and runs at 1,250 revolutions per minute, furnishing ample power to bend the largest specimens used in the machine. The motor is controlled by a switch and starting rheostat, which are mounted just above the handle of a clutch on the first gear reduction shaft. From this lever the operation of the machine is controlled by hand. To prevent damage to the outfit, an automatic stop is provided which will mechanically throw out the motor switch at the end of the return stroke if the attendant should forget to operate the hand lever. The reverse motion of the table is obtained by reversing the motor by a double throw switch.

The machine is manufactured and sold by Tinivs, Olsen & Company, of Philadelphia.

ENAMELED WIRE.

The American Electric Fuse Company, of Muskegon, Mich., has been developing a black enameled wire, the insulation of which is said to possess the qualities of toughness, tenacity and adhesiveness, together with positive dielectric strength and uniformity in quality and thickness. The hydrocarbon form of black enamel used is a closely adhesive film which is said to stretch with the wire and to withstand all the handling incidental to the manufacture of the wire into apparatus. The insulation is non-hydroscopic, and is claimed to withstand a temperature of 600 deg. Fahr. without charring, burning or materially injuring the coil. The enamel dissipates heat faster than silk or cotton and being inert as regards the action of ordinary chemicals is not detrimental to the wire itself. Its thickness is about one-quarter that of single silk for the same break-down voltage. This thinness of insulation results in saving space, and since the density of a magnetic field is directly proportional to the number of lines of force for unit of area of cross section, the advantage of such material in electrical work is evident.

HYDRAULIC TURBINE FOR NELSON, B. C.

A 1,250-horsepower hydraulic turbine has been built at the Scranton works of the Allis-Chalmers Company for the power house of the city of Nelson, B. C. The turbine and vertical alternator are both of Allis-Chalmers Company's standard design, and, after extensive tests in service, were found to be even more efficient than was claimed for them by the builders. The turbo-generator has a normal capacity of 750 kilowatts, but during the test run, at which the city officials of Nelson were present, this output was increased to 1,340 kilowatts for a period of over forty-five minutes' continuous running, without undue increase in temperature of bearings.

Up to the time of installing this unit the lighting and power loads for the city had been supplied by the West Kootenay Power and Light Company, situated just across the Kootenay River from the new city power plant, the river being the source from which both plants derive power.

NEWS NOTES

INCORPORATIONS.

PORTLAND, ORE.—Northwest Gas Equipment Company, E. H. Corbett et al.

SEATTLE, WASH.—Pasco Power and Water Co., W. H. Parry, H. K. Owens et al.

BAKER, WASH.—Skagit River Telephone & Telegraph Company, $10,000; J. C. Eden, E. J. Kellogg.

LOS ANGELES, CAL.—The Provident-Midway Oil Company, with a capital stock of $250,000, has been incorporated in this city, by T. O. Turner, W. Le Moyne Mills, L. B. Howe, C. K. Foster, and E. D. Foster.

SAN FRANCISCO, CAL.—The Nevada Petroleum Company has been incorporated here, with a capital stock of $1,000,000, shares $10 each, and $5,000 subscribed, by M. L. Requa, F. W. Bradley, J. S. Wallace, A. C. B. Fletcher, and C. A. Norris.

ROSLYN, WASH.—The Cle Elum-Roslyn Railway & Power Company has been incorporated for the purpose of building and operating an electric railway from Cle Elum to Roslyn. Capital stock, $100,000. Incorporators: Frank S. Farquhar and W. E. Farquhar.

WALLA WALLA, WASH.—The Columbia & Walla Walla Traction Company has been incorporated to construct an electric railway from Dayton to Wallula. Capital stock, $1,000,000. Officers: N. G. Blalock, president and general manager; M. R. Hanger, of Dayton, first vice-president; L. C. Davison, secretary; George Kellough, treasurer.

PHOENIX, ARIZ.—Articles of incorporation of the Phoenix, Tempe & Mesa Railway Company have been filed with the territorial auditor. The capital stock is named at $2,000,000, the object of the company being to construct a double-track electric line between Phoenix, Tempe and Mesa, the road to be finished before December of 1909.

HOOD RIVER, ORE.—Articles of incorporation have been filed by the Watt Development Co. Dr. J. F. and A. S. Watt, of Hood River, are the owners. The company owns valuable water rights and power five miles from Hood River on the river by that name, known as the Truckee power site. Development will start immediately. From 8,000 to 10,000 horsepower is available.

TRANSPORTATION.

LOS ANGELES, CAL.—P. James has filed an application with the Supervisors for a franchise for an electric road on Stephenson Avenue and Whittier Road.

GLOBE, ARIZ.—George W. P. Hunt has petitioned the City Council for a franchise for an electric street railway through Globe, agreeing that construction shall be completed within two years.

UPLAND, CAL.—W. G. Kerckhoff, representing a company of electric railway people, has reached an agreement with the Town Trustees regarding the entry here of a proposed line from Claremont. The company has filed a $10,000 bond as a guarantee of its good faith.

BISBEE, ARIZ.—The fight for the old right of way of the El Paso & Southwestern Railway between Bisbee and Douglas has been decided in favor of the Cochise County Electric Railway Company by the general commissioner of the United States land office at Washington. The publication of future plans of this company are being awaited with great interest, as an electric road would prove of great interest to the community.

FINANCIAL.

MADERA, CAL.—The election for the purpose of voting for sewer bonds in the sum of $25,000 and water bonds in the sum of $50,000, will be held January 7th.

BISBEE, ARIZ.—The City Council has passed an ordinance providing for the issuance of bonds of this city to the amount of $125,000, for the construction of municipal waterworks.

BISBEE, ARIZ.—The offer of the Luvene Company, of Chicago, for bonds, has been accepted by the City Council. The bonds consisted in $125,000 for street improvements and $125,000 for waterworks. The Luvene Company bid $250,150.

TUCSON, ARIZ.—Final papers have been drawn up for the transfer of the Benson Electric Light & Water Company's plant to a party of Chicago capitalists. It is understood that they will make extensive improvements to both plants in Benson.

PASADENA, CAL.—Mayor Early of this place has announced that during the latter portion of January or the first of February the City Council will call an election for the purpose of voting bonds to complete the municipal electric light plant. It will cost in the neighborhood of $150,000 to complete the plant.

WATERWORKS.

LOS ANGELES, CAL.—Sealed bids have been received by the Board of Water Commissioners of this city for 1 engine lathe, 1 drill press and 1 sharpener.

PORT ORCHARD, WASH.—The City Council has passed a franchise granting to A. S. Eubanks and George Cady Johnson the right to lay water mains in Port Orchard streets.

SAN MATEO, CAL.—A member of the Board of Trustees has recommended that a four-inch main be run down Cypress Avenue to H Street, and that hydrants be installed at the intersections of various streets.

SAN BERNARDINO, CAL.—Franchises have been awarded by the County Supervisors to the Bloomington Land Company's Domestic Water Pressure System to install pipe lines over certain streets of Bloomington townsite.

SAN BERNARDINO, CAL.—The Muscoy Water Company, owners of Glen Helen ranch, is planning to carry irrigation water through pipe lines instead of open ditches, as at present. The work will entail the laying of about four miles of pipe line.

OAKLAND, CAL.—Resolutions demanding speedy and favorable action of the City Council in installing a salt-water auxiliary system of fire protection were adopted this week by the directors of the Oakland Chamber of Commerce. The resolutions aver that the delay in the installation of the salt-water system has been instrumental in keeping up the high rates of insurance at present in force in Oakland.

ALAMEDA, CAL.—Louis Titus, president of the People's Water Company, has assured the members of the Alameda City Council that the company would keep its promise to install new pipes in Alameda. Six months ago the company promised to put in $7,000 worth of new pipes. Titus explained that only half of this amount had been installed because the company was busy on all sides with betterments that were absolutely necessary, and found it impossible to attend to all as quickly as desired. Titus said that during the last three years the People's Water Company and its predecessor, the Contra Costa Water Company, had installed $18,000 worth of new service, representing an increase in population in Oakland, Alameda and Berkeley of 100,000.

OIL

MEXICO.—E. H. Harriman is reported to have purchased 50,000 acres of oil land in the Tuxpal District, Maxico, where oil has recently been discovered.

ESCONDIDO, CAL.—Arrangements have been made by F. M. Jones, representing the Standard Oil Company, for the erection of two steel oil tanks on the company's property in Escondido, each tank to have a capacity of 20,000 gallons.

REDONDO, CAL.—The Amalgamated Oil Company has leased two blocks of land between the Standard Oil Company's tanks and the power plant and will erect supply tanks and a pumping plant. A pipe line is to be laid, according to the plans, to the end of wharf 1, to facilitate loading. More than $40,000 is to be expended in the work.

FRESNO, CAL.—Emil, Hugo, Adolph and Charles Kreyenhagen have leased for ten years to Robert Koenitzer of St. Louis certain oil lands, operations to begin in 60 days and actual work of drilling in 90 days, to be continued for a depth of 3,000 feet to produce ten barrels a day wells, at least ten wells to be completed one after another if the land is proven oil bearing and these to be kept producing during the lease unless the price of oil is less than 30 cents per barrel. The Kreyenhagens will receive for the lease one-eighth interest in all oil and one eighth of gross receipts from gas, minerals and other sold products of the leasehold.

TELEPHONE AND TELEGRAPH.

CENTRALIA, WASH.—Oscar Foote is seeking a telephone franchise in this place.

CENTRALIA, WASH.—The Pacific Telephone & Telegraph Company has appropriated $35,000 to put in an entirely new system in Centralia.

CENTRALIA, WASH.—The County Commissioners granted a telephone franchise to the Mountain View Farmers' Telephone Company.

MOUNT VERNON, WASH.—The Farmers' Mutual Telephone Company No. 2 has been granted a franchise to build and operate a telephone system in this city.

STEPTOE, WASH.—The members of the telephone company owning farmers' line No. 3 held a business meeting recently and decided to reconstruct the line.

MODESTO, CAL.—The Board of Supervisors of Stanislaus County has granted permission to Mr. Harris, representing interested parties, to erect a telephone line along certain portions of the County Road.

SONORA, CAL.—The Tuolumne Water Power Company has made application for a franchise granting to it the right to construct and operate a telephone line in Sonora. Sealed bids are to be received up to February 1, 1909.

VALLEJO, CAL.—Several prominent Solano County capitalists are negotiating with the Pacific Telephone & Telegraph Company for the purchase of the Suisun, Benicia, Fairfield, Vacaville, Elmira, and Dixon systems of the company. Among the men interested in the deal are Attorney T. T. C. Gregory, president of the Vallejo & Northern Electric Road, County Assessor E. E. Long, and William Pierce. O. A. Haydenfeldt represents the telephone company in the proceedings.

MARE ISLAND, CAL.—Master Electrician George I. Hanscome is anxious to install a more powerful wireless station at Mare Island Navy Yard, stating that this is needed in order that operators may get into communication with stations 3,000 miles distant. Mr. Hanscome recently returned from Alaska, where he attended to the installation of a new wireless station near Valdez. While in the North, Mr. Hanscome was able to get into communication with the Honolulu station from Sitka. Another reason advanced by the master electrician for the installation of a more powerful plant at Mare Island, is that the interference with Government messages, caused by the many small experimental stations about the bay, would be done away with in this event.

MOUNT VERNON, WASH.—The telephone committee reported in favor of the franchise of the Independent Telephone Company, which agrees to establish free telephone connections between this city and Conway, Fir, Sedro-Woolley, and Burlington, and agrees to give the city an efficient service.

WINLOCK, WASH.—Oscar Foote, who this week applied for a telephone franchise in Centralia, also seeks one in Winlock. There is not expected to be any objection to the plan, and it is stated that Mr. Foote contemplates spending about $8,000 in Winlock.

SANDPOINT, IDAHO.—Extensive improvements are planned in the Pend d'Orielle national forest next year. Three new telephone lines will be built, the first from Sandpoint to Cocolalla and thence to Bridgeview ranger station; the second from Vilad around the upper end of the lake to Lakeview, and the third from Bonners Ferry to Summit and then to Eastport, Idaho.

TRANSMISSION.

EUGENE, ORE.—Bids will be received up to January 11 for constructing a 2400-horsepower plant on the McKenzie River for pumping water from the river to Eugene.

GRANGEVILLE, IDA.—Ben Davis has purchased the White Bird Electric Company and will improve it by adding new machinery. The plant is operated by water power.

KENNEWICK, WASH.—The Columbia Basin Light & Power Company has asked permission of the Council to erect a high voltage transmission line from its plant to Washington Street and thence to Garden Tracts.

SANDPOINT, IDA.—The Humbird Lumber Company has announced plans for the construction next year of two power plants in connection with the company's Sandpoint and Kootenai mills, and a pumping plant at Kootenai.

SEATTLE, WASH.—A decision has been handed down by the Superior Court that the Pacific Coast Power Company, which is engaged in building a large power plant on White River, has a right to condemn lands along the river by showing that the waters of the stream are to be devoted to public use.

SAN ANDREAS, CAL.—Frank Z. Towle has filed claim to 40,000 inches of water of the south fork of the Mokelumne River, to be diverted below the junction of South and Licking Forks, also a claim to 20,000 inches of water of the middle fork of the Mokelumne River, to be diverted on the land of James Porteous.

OROVILLE, CAL.—For the first time electric power was turned into the cables of the Great Western Power Company from the company's plant at Big Bend, the Berkeley hills being lighted through the transmission of the power. Sixty-three thousand horsepower was put upon the cables to test their efficiency, the test proving entirely satisfactory. The company's lines have been completed as far as the Bay.

EUREKA, CAL.—The Snow Mountain Power Company has ordered a 4,000 h.p. horizontal turbine for 450-foot head at 450 r.p.m. direct connected to a three phase 60 cycle, 2,300 volt A. C. generator, also a 150 h.p. exciter set to be driven by a horizontal impulse wheel. This equipment is to be furnished by the Allis-Chalmers Company. F. G. Baum of San Francisco is consulting engineer for the power company.

REDDING, CAL.—The fourth power plant of the Northern California Power Company was started up last week for the first time, adding 3,000 horsepower to the system and making a total of 13,000 horsepower. The new plant is near Volta where the company has two other plants. A fourth plant of the company is at Kilarc, Shasta County. A fifth plant is now under construction on South Battle Creek, where 5,500 horsepower will be developed. The company intends to erect a sixth plant in the vicinity of the fifth with a development of 8,500 horsepower.

RENO, NEV.—As the result of extremely cold weather, an ice gorge formed last week blocking the Truckee River at a point above Floriston and the power companies supplying electric power to Carson, Reno and the mines of Virginia City, had hard times keeping their lines open. The Butters plant, one of the largest in Virginia City, was compelled to close down, while Carson City was without light and power. An auxiliary plant in this city was all that kept Reno in light and power.

ILLUMINATION.

MADERA, CAL.—William N. Parker is seeking a franchise for the installation of gas works in this city.

AZTEC, NEW MEXICO.—An electric light franchise has been granted by the City Trustees to the Eden Canal, Land & Power Company.

PASADENA, CAL.—The City Council has awarded the contract for the supplying of 8,000 arc-light carbons, to the National Carbon Company.

ENTERPRISE, NEW MEXICO.—The Board of Trustees is considering the installation of a street lighting system, none having been decided upon as yet.

SIERRA MADRE, CAL.—The Board of Trustees of this place has called an election for February 24th, for the purpose of voting on the construction of a municipal gas plant.

POINT ARENA, CAL.—Application has been made to the Town Trustees of this place by C. E. Boyd, manager of the oil well here, for a franchise to install an electric light plant.

OAKLAND, CAL.—The Seventh Street Improvement Club has accepted the bid of the United Iron Works for the erection of 150 electroliers in Seventh Street, from Broadway to Bay Street in East Oakland.

SAN DIEGO, CAL.—C Street, from Third to Sixth, and Fifth Street, from B to C, will be electric lighted in the near future, a petition of the property owners for the same having been granted by the City Council.

NEWPORT, CAL.—The bid of the Standard Iron Works, of SanDiego, for twenty-five iron lamp-posts and the same number of four-burner arc lights, has been accepted by the Board of Trustees. The bid was $987.50

DAYTON, NEW MEXICO.—The Dayton Gas & Oil Company is having its well near here repacked and cased with fine threaded piping to prevent the escape of gas. The company intends to start work immediately in laying a main to the town and bringing gas in at once.

SAN FRANCISCO, CAL.—A design for the lamp standards to be placed on Market, Valencia, and Sutter Streets by the United Railroads, has been prepared by the architectural firm of D. H. Burnham & Co. The work of placing the posts in position will begin as soon as the castings can be made

PORTLAND, ORE.—Local capital, with offices at 338 Chamber of Commerce, has purchased the St. John Gas, Light & Heat Co., and will proceed to sell seock for the purpose of putting up a plant. W. S. Dole & Co., Lumber Exchange, are the consulting engineers. A site has already been secured.

ABERDEEN, WASH.—Electric lighting for South Aberdeen and Cosmopolis has been decided upon by the Grays Harbor Railway & Light Company, according to the statement made by Manager Crary. This will involve the expenditure for cable, wiring and lights of a sum estimated between $10,000 and $15,000.

OGDEN, UTAH.—Announcement has been made through Salt Lake City persons that Henry L. Lee, who was here a few weeks ago investigating the outlook for a new gas plant, has made a very favorable report to the New York company which holds the franchise, for a new gas system in Ogden.

ONTARIO, CAL.—Sealed bids will be received by the Town Clerk of Ontario, California, up to February 2d, for a franchise granting the right to lay gas pipes and conduits for a period of fifty years through the public streets and thoroughfares of the town, for the purpose of carrying and distributing gas for light and heat.

TRANSPORTATION.

BOISE, IDA.—A site has been selected for a depot to be built by the Boise & Interurban Railroad Company at Eagle.

AYLMER, ORE.—It is announced that the Hull Electric Company expects to construct two miles of new track next year.

TACOMA, WASH.—A franchise was granted to the Pacific Traction Company to construct a street car line on Eighth Street.

VANCOUVER, B. C.—The British Columbia Electric Railway Company is in the market for car trucks for six equipments.

ELLENSBURG, WASH.—The petition of A. S. Randall for a franchise for an electric line from South Cle Elum to Cle Elum Lake will be heard on January 11th by the county commissioners.

SPOKANE, WASH.—The Okanogan Electric Railway expects to begin construction in the Spring upon a line from the junction of the Okanogan and Columbia Rivers north along the Okanogan to a point near the Canadian line.

VALLEJO, CAL.—Randall, Trowbridge & Company, Oakland, Cal., have applied to the City Trustees for a franchise covering the principal streets of Vallejo, with the intention of constructing and operating an electric railway system.

CENTRALIA, WASH.—W. J. Patterson and A. Welch, who are identified with the electric railway system at Vancouver, Wash., have been granted a franchise to build and operate an electric railway in Centralia.

TACOMA, WASH.—The Puget Sound Electric Railroad has petitioned the Commissioners for a franchise for a new line from Brookville to Puyallup. The petition states that the company will construct either single or double tracks, and that steps have already been taken to acquire a right-of-way.

PORTLAND, ORE.—Announcement is made that during 1909 the United Railways Company will construct fifty miles of additional track. During the past year, the company built twenty miles of track from Claremont to Glen Harbor, Linnton and Holbrook.

CLE ELUM, WASH.—Through Frank S. Farquhar the Cle Elum-Rosyln Electric Railway & Power Co. applied to the county commissioners for franchise giving them the right to use the county road between Cle Elum and Rosyln. The commissioners set January 11th, 1909, for hearing of the matter, when the franchise will undoubtedly be granted.

WALLA WALLA, WASH.—Propositions for the construction of the entire road from Dayton to the river now are occupying the attention of the Walla Walla & Columbia River Traction Company. All propositions for grading and laying of steel are receiving careful consideration, and the contract will be left within a few days for the building of the entire line.

LIVINGSTON, MONT.—Engineers representing the motor power department of the Northern Pacific Railroad have been in Livingston, Mont., working on a plan to use electricity in carrying trains over the mountains just west of the city. It is stated that the proposition is being investigated and that at an early day electric power is likely to be used in pulling both passenger and freight trains over the mountains. If the plan is adopted the company will construct a large power plant at some point on the Yellowstone River.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public — the consumer — who will listen with a willing and eager ear to the story of quality.
Take your case before this court with your strongest arguments and state your reasons for appreciation.

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Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

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ierulff, B. F. Jr. & Co., "Hubbard."
lein & Sons, Mathias.

ANNUNCIATORS

dwards & Co.
lec. Goods Mfg. Co., "Ross," "Rivol," "Perfect," "Noxall."
artrick, Carter & Wilkins Co., "King."
tandard Elec. Wks, "C.&S."
tanley & Patterson, Inc.
Vestern Electric Co.

ARMS

CROSS ARMS

ierulff B. F., Jr. & Co.
alifornia Pole & Piling Co.
alworth & Neville Mfg. Co.
Vestern Electric Co., "Walworth & Neville."

MAST ARMS

lec. Appliance Co., "Cutter"
t. Wayne Electric Works.
ierulff, B. F., Jr. & Co., "Cutter."
Vestern Elec. Co., "Fletcher"

TELEPHONE TRANSMITTER ARMS

ean Electric Co.
lec. Appliance Co., "Eaco."
ierulff, B. F., Jr. & Co., "Sterling."
terling Elec. Co.
Vestern Elec. Co.

INDEX TO ADVERTISEMENTS

ASBESTOS

Johns-Manville Co., H. W.

BATTERIES

DRY BATTERIES

Dean Electric Co.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia." "King."
Sterling Elec. Co., "Bear," "Sequoia."
Stanley & Patterson, Inc., "Exeter." "Matchless."
Western Electric Co., "Blue Bell." "Liberty."

DRY BATTERY HOLDERS

Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES

Partrick,Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic." "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY

Elec. Goods Mfg. Co., "Samson." "Noswas."
Partrick,Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal." "Faraday."
Western Electric Co.

STORAGE BATTERIES

Elec. Storage Battery Co.
Westghse Machine Co.

BELLS

ELECTRIC BELLS

Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick,Carter & Wilkins Co.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

ELECTRO-MECHANICAL GONGS

Edwards & Co.
Electric Goods Mfg. Co.
Marshall Elec. Co.
Partrick,Carter & Wilkins Co.

MAGNETO BELLS

Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

BOILERS

Henshaw-Bulkley & Co.
Keystone Boiler Wks., "Parker."
Moore & Co., Chas. C., "B. & W."
Standard Electrical Works, "Robb-Mumford."
Tracy Engineering Company, "Edge Moor."

BOXES

FLOOR AND OUTLET BOXES

Krantz, H., Mfg. Co.

JUNCTION BOXES

Krantz, H., Mfg. Co.

WALL BOXES

Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knockout."
Chicago Fuse Wire & Mfg. Co., "Union."
Cole Co., John R., "Bossert."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
General Electric Co.
Harvard Elec. Co.
Holabird-Reynolds Elec. Co.
Krantz Mfg. Co., H., "De Rycke."
Marshall Electric Co.
Standard Elect'l Wks., "M & M."
Stanley & Patterson, Inc., "Simplex."

BRACKETS

CEILING BRACKET AND DESK FIXTURES

Stanley & Patterson, Inc., "Sunlight."

DESK TELEPHONE BRACKETS

Stanley & Patterson, Inc., "Imperial."
Sterling Elec. Co. "Equipoise."
Western Electric Co

IRON POLE BRACKETS

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Cutter."
Pierson, Roeding & Co.
Western Elec. Co, "Fletcher"

BURNERS

ELECTRIC GAS LIGHTING BURNERS

Electric Goods Mfg. Co., "Advance."
Edwards & Co.
Welsbach Company.
Western Electric Co., "Edwards."

BUSHINGS

Krantz, H., Mfg. Co.

CABLES

SUBMARINE AND LEAD-COVERED

American Electrical Works.
Belden Manufacturing Co.
Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
National Conduit & Cable Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
Standard Electrical Works, "Simplex."
Standard Underground Cable Co.
Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

PAPER INSULATION

Belden Manufacturing Co.
Nat'l. Conduit & Cable Co.
Western Electric Co.

TELEPHONE CABLE

Dean Electric Co.

CABINETS

SPECIAL CABINET WORK

Krantz Mfg. Co., H.

STEEL AND IRON CABINETS AND FRAMES

Krantz Mfg. Co., H.

CARBONS

ARC LIGHT CARBONS

Brooks-Follis Elec. Corp'n, The, "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The, "I-T-E," "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
Kierulff, Jr., & Co., B. F. "Hartman."
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLEATS

FIBRE CLEATS

Blake Signal & Mfg. Co.

PORCELAIN CLEATS

General Electric Co.
Holabird-Reynolds Elec. Co., "Electric Porcelain."
Thomas & Sons Co., R.
Weber Elec. Co., H. D. Sears, general sales agent.
Western Elec. Co., "Thomas"

WOOD KNOBS

Blake Signal & Mfg. Co.

CLUSTERS

FIXTURE CLUSTERS

Benjamin Electric Mfg. Co., "Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbell."

COILS

ARMATURE AND FIELD COILS

Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Deltabeston."
Westghse Elec. & Mfg. Co.

INDUCTION COILS

Electric Goods Mfg. Co.
Partrick,Carter & Wilkins Co.
Western Electric Co.

SPARK COILS

American Electrical Works.
Electric Goods Mfg. Co.
Western Electric Co.

COMPOUNDS

BOILER COMPOUNDS

Dearborn Drug & Chemical Works.
Johns-Manville Co., H. W., "Magic."

CONDUIT

FLEXIBLE CONDUIT

American Circular Loom Co., "Circular Loom."
Cole Co., John R., "Circular Loom."

RIGID CONDUIT

American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct." "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roeblings Sons Co., J. A. "Navalite."
Cole Co., John R., "Electroduct."

UNDERGROUND CONDUIT

Johns-Manville Co., H. W., "J.-M."
Pierson, Roeding & Co., "Fibre."
Roeblings Sons Co., J. A., "Bituminized Fiber."
Walworth & Neville Mfg. Co.
Western Electric Co., Agents Walworth & Neville Mfg. Co

CONDUIT CLAMPS

Krantz, H., Mfg. Co.

CONNECTORS

CABLE CONNECTORS

Belden Manufacturing Co.
Chicago Fuse Wire & Mfg. Co.
Harvard Elec. Co.
Kierulff, B. F., Jr. & Co.

CORD

FLEXIBLE BELL CORD

American Electrical Works.
Belden Manufacturing Co.
General Electric Co.
Kierulff, B. F. Jr. & Co., "National."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roebling Sons Co., John A.
Simplex Elec. Co.
Western Electric Co.

LAMP CORD

American Electrical Works.
Belden Mfg. Co.
Elec. Appliance Co., "Paranite."
General Electric Co.
Okonite Co., The. "Okonite."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roeblings Sons Co., John A.
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Std. Elec. Wks., "Simplex."
Standard Und. Cable Co.
Western Elec. Co., "Victor."

MARINE ENGINES
Standard Elec. Works, "Engbery."

STEAM ENGINES
Allis-Chalmers Co.
Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Tracy Engineering Co., The
Westghse Machine Co.

FANS

DESK AND BRACKET ALTERNATING CURRENT FANS
Ft. Wayne Electrical Works.
General Electric Co., "G. E."
Standard Electrical Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

EXHAUST FANS
General Electric Co.
Standard Elec. Wks., "M. A. Co."
Wagner Electric Mfg. Co.
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co.

FIXTURES

CEILING, BRACKET AND DESK FIXTURES
Benjamin Electric Mfg. Co.
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MARINE FIXTURES
Benjamin Electric Mfg. Co.
Dale Co.
Electric Appliance Co.
Sterling Electric Co.

SHOW CASE FIXTURES
Benjamin Electric Mfg. Co.
Dale Co.
Johns-Manville Co., H. W., "Linolite."

STAGE FIXTURES
Chase-Shawmut Co., "Shawmut."

FUSE MATERIAL

ENCLOSED FUSES AND FITTINGS
Bryant Electric Co.
Chase-Shawmut Co., "Shawmut."
Chicago Fuse Wire Mfg. Co., "Union."
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W., "Noark."
Marshall Electric Co.
Perkins Elec. Switch Mfg. Co.
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

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Including Service Boxes, Subway Boxes and Junction Cut Outs for use with enclosed fuses.
D. & W. Fuse Co., "D. & W."
Johns-Manville Co., H. W., "Noark."

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Chase-Shawmut Co., "Shawmut."
Chicago Fuse Wire & Mfg. Co.
General Electric Co.
Harvard Electric Co.
Pass & Seymour.
Pierson, Roeding & Co., "Aluminum."

MISCELLANEOUS FUSES
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Harvard Electric Co.
Marshall Electric Co.
Perkins Elec. Switch Mfg. Co.
Weber Elec. Co., H. D. Sears Gen'l Sales Agt.

TELEPHONE FUSES
Dean Electric Co.
D. & W. Fuse Co.
Kierulff, B. F. Jr. & Co., "Sterling."
Standard Elec. Wks., "Couch & Seeley."
Western Electric Co.

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THE FIRST UNDERHUNG INSULATORS

By A. S. Kalenborn

When the new type of underhung, high-tension insulator was introduced, most of us were impressed by the radical change from the old pin-supported type, and, no doubt, considered the idea of underhanging as quite original and entirely new.

During a recent trip into the Sierras in the vicinity of Lake Tahoe, I came across the antiquated, almost forgotten prototypes of these new high-tension insulators. preservative, apparently bitumen, and are in good condition, although they have been exposed to the weather for many years.

On the top of the enclosing cast-iron cylinder of the insulator, which, with the pin, is heavily galvanized, are the words, "Brooks' Pat. August 6, 1867." It seems, therefore, that before some of us were born these underhung insulators were out in the world doing an important work.

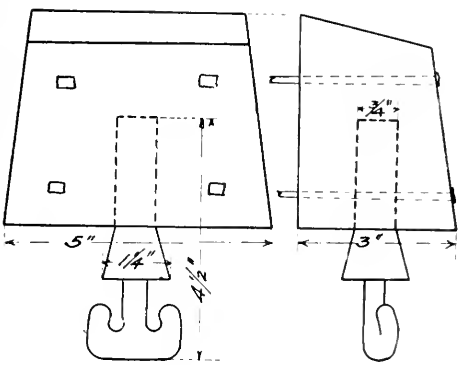
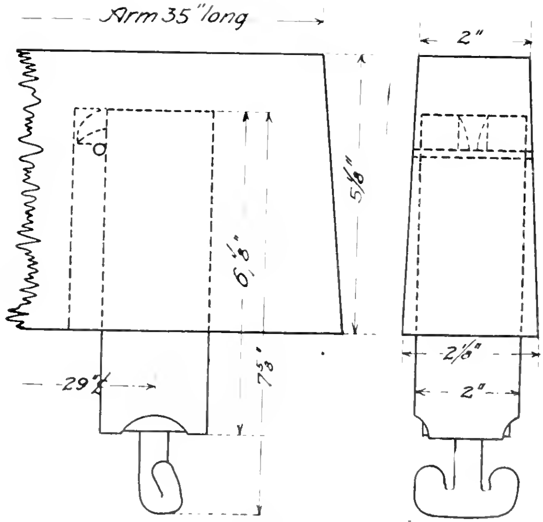


Fig. 1. Western Union Insulator.



Central Pacific R. R. Insulator.

One of these used by the Central Pacific Railroad is quite an elaborate piece of work, consisting of three separate parts, which are cemented together with sulphur, and an additional iron pin or spike to secure the combination within the cross-arm. A thin cast-iron cup with a lug near the closed end was secured, open end downward, within the arm by a pin, as indicated in the line drawing. Within this, cemented by means of sulphur, was an open-mouthed bottle of glass, and "sulphured" within the bottle was the hook for holding the wire.

Figure 1 shows the arm and the method of supporting the insulator. The wire was held without a tie by being bent into the hook, the kink formed thereby preventing displacement or slipping. The arms were treated with some Later the glass pin-supported insulators superseded these at considerably reduced cost.

The other type of telegraph insulator is simpler, smaller, and of less cost and weight than the first, as it weighs complete only 5 ounces, as compared to 1 pound 10 ounces for the larger one.

This one, which was used on the Western Union line along the wagon road from Truckee to Lake Tahoe, and which, as shown, consists of only two component parts, the galvanized iron hook and a rubber sleeve cast onto the shank. The sleeve being threaded was screwed into the under side of an arm or block secured to a pole or a tree. The Truckee-Tahoe line was run through the forest, and

small blocks, as shown, were nailed to the trees, the bark of which has in many instances almost enclosed them at this date.

Around the shank, apparently stamped into the rubber, are the words, "Goodyear's Patent. May 6, 1851," which takes us back to the very early days of the telegraph, or eighteen years prior to the laying of the first transatlantic cable.

Thus we see that our "newest" insulators are in reality but a modification of the earliest ones, and the principle long discarded is the one which solves the problem of utilizing extra high voltages.

HANDLING OPERATORS.*

The question of operators' loads, or the average number of calls that an operator should handle, is one which is probably asked oftener than any other question pertaining to operating. This question is often asked for comparison, sometimes for information, and it is really one which every one has to answer for himself. No one can tell another how many calls his operators should handle per hour, unless he is thoroughly familiar with the conditions. He can say about so many, and be very close, but the number of calls which an operator can handle or the average number that operators are loaded to for a busy hour can only be determined by careful loading and observation. Conditions govern this figure entirely. A single office system, straight work, and a short reach would naturally permit the handling of more calls by an operator than one where there is trunking to do, various kinds of service, etc. Further than that, the standard average answering service to be maintained must also be considered where determining the average number of calls the operators are to handle during the busy hours. Operators do their best work when they are given just enough to keep them busy, and not so much that they are always rushed.

A great many methods of testing operators are used, and they all are good, but some are better than others for the reason that they are more complete and more information can be gotten, and consequently better results. Listening desks, observation desks, and all apparatus of this kind are very good and quite necessary, even in the smallest offices, but they must be used constantly to be of any great value. The operators' errors and faults are found out by means of this apparatus, and to get results from this information it is best, or at least quicker results can be obtained, by taking them up with the operator at once.

Too much attention cannot be given to the testing of answering service. This in itself does not mean all that there is to good service, but it goes a long way toward making it up. Answering tests cannot be made too often, and to maintain a good answering time it is necessary to keep up the testing daily. It is not necessary that the answering time alone be tested. All the conditions that a subscriber may meet should also be tested, and this can be done in connection with the answering test. In large exchanges the all-night test should be kept up as well as the day or evening test, and in exchanges where this has not been done, or to those who have not had some experience, the tests for the first few nights may be a little surprising.

In a modern common-battery exchange of any size, the average answering time for the day and evening hours should be kept under four seconds, and with regular testing and good supervision this can be done.

*[illegible] Traffic, presented at the convention of the [illegible] Telephone Association, Dec. 1908, by A. J. Shields.

THE LEGAL STATUS AND RELATIONSHIP OF INDEPENDENT TELEPHONE COMPANIES.*

By A. C. Lindemuth.

Hitherto little attention has been given by this association to the consideration of legal questions affecting independent telephone companies as a whole and as to their relationship with each other. Individual companies have looked after their own legal matters in their own way, and naturally their investigation and concern have rarely extended beyond their own immediate interests. This will account for the lack of information upon these broader questions, the importance of which every layman felt, but in which, of course, he was not expected to be versed. This, too, may be one reason why associated independent companies have been somewhat tardy in asserting their rights under the law. During the last year some considerable investigation has been given to these important legal propositions, and steps have been taken, or are about to be taken, which will result, I apprehend, in ascertaining and making known more clearly the relative rights, duties, and liabilities of independent telephone companies for the benefit of all. It is impossible, of course, in a short paper like this to consider many of these questions, or to discuss them at much length. At most, I can only hope to plainly and concisely present a few important and interesting points. Nor, at this time, shall I cite the decisions in support of them, although many of the propositions have been briefed, and authorities thereon fully collected, and tabulated for ready reference when occasion arises.

Interests Involved in the Operation of a Telephone Plant And Their Reciprocal Rights and Duties.

In the operation of every commercial exchange, three interests are involved, which have reciprocal legal rights and duties. These three interests are the management, the investor, and the public. There is still a fourth interest, and an important one with respect to independent telephone companies, which I shall discuss as a separate proposition, namely, the legal relationship between associated or connecting independent companies.

It is the law that the officers and employees who constitute the management or administrative side of the business have a right to just compensation for services rendered, and in return therefor they owe a legal duty to the investor and the public to give the company their best skill and efforts, and this means that the most efficient results shall be attained at the least possible cost. This rule of law applies equally to the management of the company's affairs in all its branches, whether purely administrative or whether relating to the physical property, such as maintenance, operation, or construction. High efficiency economically attained is their legal bounden duty, and their right, fair compensation.

The investor who furnishes the capital with which to construct and develop the utility for the public convenience is by law entitled to the security of his investment and a fair return thereon. Too often the investor is regarded by the public in an unfriendly attitude. There is neither ground for nor benefit to be derived by any one from this. Without capital, public utilities cannot be constructed, and without them modern business conditions could hardly go on; therefore, the safety of the investment must be absolutely assured, and the return thereon reasonably adequate to attract capital. If the people are to have these utilities, the interest of the investor must be considered in the fixing of rates.

In all legal controversies upon the question of rates the right of the investor to a fair return on his investment is

*Paper read at the convention of the International Independent Telephone Association.

considered and fully recognized by the courts, as it should be. And so, in States where the authority to fix rates is vested in utilities commissions, the same rule of law is applied in the determination of what a reasonable rate should be.

The public, under the law, have a right to the best possible service, and owe a duty therefor to pay a reasonable rate. The service, of course, is dependent upon the kind of plant, the state of repair in which the same is kept, and the efficiency of operation. The character and cost of construction should be adapted to the size of the town or city, the ability of the people to pay for telephone service and such as will justify the investment. The law would not expect or require the same degree of efficiency in service in small towns and villages as it would in larger towns and cities, unless as a practical proposition such efficiency could be obtained with simpler and less expensive equipment. So, too, the law would regard as unreasonable and therefore would not enforce a regulation on the part of a town or village requiring a telephone company to put in underground conduit or other expensive construction.

The Relationship of Independent Telephone Companies with Respect to Each Other.

The relationship of independent telephone companies to their connecting independent telephone companies and other associated interests has never, in my judgment, been fully understood or considered. The use of the word "sentiment" to indicate this relationship is, it seems to me, a very mild expression for the mutual obligation existing between them. There is, it is true, a "sentiment" in maintaining independent relations when once assumed, and a moral obligation also, but there is something more than this. There is, in my opinion, a legal duty and liability. No sound business man would undertake to run a business on sentiment alone, nor would he admit sentiment to enter as a material factor in the ownership or control of the business property. The telephone business, while possessing many peculiarities, should be no exception in this regard, and in treating the relationship existing between independent companies as a sentimental one, we have overlooked the stronger and more practical obligation, and thus materially weakened our position. This mistaken idea has furnished an easy excuse for certain independent companies which have disregarded their legal obligations to the other independent companies, and connected up with the rival system, and for any who may be considering such a connection.

This relation of one independent company to its connecting independent companies constitutes an implied contract whose breach involves not only bad business faith, but also, as I believe, a legal liability. In fixing the legal status of connecting independent companies with respect to each other, four elements are to be considered.

The relationship of the independent company (1) to the charter granting power, (2) to its subscribers, (3) to its security holders, and (4) to its connecting independent companies.

When practically every independent telephone company was organized, it was organized and held itself out to the public as an independent company in competition with its rival system. This was, as a rule, plainly made manifest in the articles of incorporation, the ordinances and franchises, the literature and advertisements, by the public declarations.

1. When it procured its franchise from the charter granting power, whether from the State or municipality, it procured the same mainly upon its representations that it was an independent company—that is, independent of the then existing company—and was organized and intended to be operated in opposition to and in competition with such existing system. In fact, this was the main, if not the sole, consideration for the grant. In granting the franchise, the State or municipality had in contemplation the establishment of a competing telephone system. The reduction in rates, the limitation in the term of the franchise, the provisions for improved and increased telephone facilities, almost universally appearing in the grant indicate this, and in perhaps the majority of cases there was inserted a specific clause, absolutely prohibiting the assignment of the rights thereunder to any existing or competing company without the consent of the charter-granting power.

But even if not in any manner expressed in the grant, it was a matter of general notoriety, provable in a court of law by acts and declarations at the time the franchise was asked for and obtained, that the main consideration therefore was to secure to the people the benefits of competition in telephone service. What the telephone conditions were in the United States prior to the origin and development of the independent movement have been so often told and are too well known to need repetition here. It is sufficient to say that the telephone business was in the hands of a monopoly, the rates were exorbitant, the service poor, the company exclusive and unprogressive, and the treatment of the public by it arbitrary, dilatory, and discourteous. The independent movement was general throughout the country, and the literature of the times on the necessity and cause for its existence would fill many volumes. The impelling motive in all these grants of franchise and telephone privileges to independent companies was competition.

A desire to secure to the people by and through competition, the benefits of reasonable rates, superior service, the stimulation of rivalry in invention, improvement in equipment, and perfection in the art of its operation; also a large development of the field and a greater extension of telephone facilities to the residential and outlying districts of cities and towns, villages and rural communities, and all the other benefits which naturally flow from competition. But for these the grant would undoubtedly not have been made. The city council or town board would not have given another and additional franchise to the existing company, which already had one plant installed, for without competition no substantial benefits could have flowed from such grant. In fact, bonds were exacted from many independent companies that actual work should be begun within a certain time, and great caution was taken that such franchises should not be left open to become the subject of barter and trade with the rival system. And what was the purpose of all this if not to make sure that competition was not only to be established, but to be maintained? Independence and competition were therefore indelibly impressed upon their charters, and gave legal significance to their relationship to the charter-granting body.

Hence the relationship of the independent company to the municipal corporation, or franchise-granting power, constituted not a mere sentiment, but a contract either express or implied and enforceable in law, and was based upon competition as the main consideration for its establishment.

The benefit of competition was a very important and valuable consideration, not only adequate to support the grant, but irrevocable by the one without the consent of the other. It is both law and reason that that which was the chief consideration for the public rights and privileges secured, cannot be set aside or avoided at the will or pleasure of the telephone company.

2. When the independent company solicited and procured subscribers to its exchange, it did so holding itself out and representing itself as an independent company in competition with the old company. In doing so it created a legal obligation between itself and the subscriber to so maintain itself. Invariably it offered reduced rates, better service, fairer treatment, and its connections as a part of the independent system as inducements for their patronage, and these were the very expressions of competition and the very benefits to flow therefrom.

The telephone patron has a dual protection for his rights and interests in the company's service: his interests as a citizen, which are represented by the municipality or town board, and the other by his individual contract, express or implied. Under his individual rights, the independent company cannot lawfully substitute another and a different service from that expressly or impliedly contracted for, or otherwise vary its obligations to its subscribers without his consent.

3. When the independent company placed its securities on the market and sold its stock or bonds, it did so as an avowed independent company, in competition with the old and existing company. Even if no positive or direct representation were made at the time, the purchaser knew, or had a legal right to take notice of, the public acts and declarations of the company and those in control, and was likewise bound to know the nature and obligation of the grant and the interests of the public in the maintenance of competition. The relationship to an implied contract of the company with the charter-granting power, the subscribers, and the connecting independent companies were facts of which the security purchaser was bound to take knowledge, and he took his securities subject to their pre-established rights.

On the other hand, if this independent status and relationship so openly assumed and avowed by the company imparted strength and value to the securities, the security holder, whether stock or bond owner, has a legal right to have that status and relationship maintained, unless altered by law. This right has not to my knowledge been asserted in any instance, yet when security holders begin to realize that their stocks and bonds may become imperiled by the surrender of the independent company to its rival and the destruction of competition, he will no doubt be heard from in the courts.

The interests of the minority stockholder are now about to be tested in the Dubuque, Iowa, case, and there is ample support in law for the protection of his rights by appealing to the courts to prevent the independent company from deserting its independence and destroying competition by an illegal merger, and thereby depreciating or destroying the value of his stock.

In my judgment, when an independent company, having held itself out and represented itself to be an independent company, in competition with the old or opposition company, secures its franchises under such representations, sells its securities under such representations, then connects up with other independent companies as a part of the independent system, the connection of the one company is a good consideration for the connection of the other, and there is thus created an implied contract and a legal obligation to maintain the independent and competitive status, and a legal liability when such obligation is violated, and this, in my opinion, is true even in the absence of an express or exclusive contract.

There is a familiar rule of law in relation to partnerships that one who himself holds as a partner, allowing his name to be used on the signs and stationery of the firm, is estopped from denying his relationship and is liable for [illegible]'s debts, even though he is not a partner and has [illegible] a dollar of interest in the firm. So, too, when one [illegible] to another to build certain construc[illegible] on his premises for certain purposes, and on the [illegible]ength of such license and in pursuance thereof enters [illegible]ntracts and incurs expenses on account thereof, the [illegible] owner may revoke such license, but he must make [illegible] the licensee for his losses, even though the license [illegible]ations.

[illegible] is a general rule analogous to these principles [illegible]plies, in my opinion, to the connections of inde[illegible] companies with each other as a part of the inde[illegible]stem. When a party holds himself out or represents himself to be in a certain state, relation, or condition whereby the other party deals with him upon the faith and credit of such pretensions, and incurs obligations or expenses on account thereof, the first party is estopped from denying such state, relation, or conditions, and is legally bound to maintain the same or respond in damages for an infraction of such legal duty.

Therefore, when an independent company connects up with another independent company as an independent company in competition with their common rival, as indicated above, and a business is built up between them, then, in my opinion, they are bound in law to maintain such relation or stand liable in an action for damages for a breach of such implied contract. The position of an independent company as an independent competitive company and as an integral part of the independent system with its independent connections and business relations is a valuable consideration to support such an implied contract, and constitute an important asset whose value can hardly be realized by one not conversant with the telephone history and the nature of the telephone business.

That an exclusive contract, that is, a contract for independent connections only, and the delivery of the entire business of the one company for the territory of the other, exclusively to the other company, for a term definite, is a valid and binding contract enforceable in law, has now been decided in four of the lower courts: by Judge Mathias, of the Court of Common Pleas of Van Wert, Ohio, on Oct. 12, 1908, in the case of the United States Telephone Company vs. the Middle Point Home Telephone Company; by Judge Quayle, of the Common Pleas Court of Allen County, Ohio, on the 28th day of July, 1908, in the case of the United States Telephone Company vs. The Delphos Telephone Company; by the Supreme Court of Wayne County, New York, on the 14th day of September, 1908, in the case of Wayne-Monroe Telephone Company vs. Ontario Telephone Company and the Empire State Telephone & Telegraph Company; also in a much earlier decision by the Wabash Circuit Court of Wabash County, Indiana, rendered on the 5th day of May, 1906, in the case of The North Manchester Telephone Company vs. The Eel River Valley Telephone Company. In no case has there been a decision to the contrary.

In these cases the rival company set up the plea that such exclusive contracts were in restraint of trade and tended to create a monopoly and were therefore void. But the courts held that such exclusive contracts when not made between competing systems were, in fact, an aid of competition, and perfectly valid. It is manifest that this must be so, for the very purpose of such exclusive contracts for connecting up and interchanging business between independent telephone companies was, and is, to build up and maintain an organized system in commercial rivalry with the monopolistic system. There could be no real and effective competition under universal connections. Hence the courts could not have decided otherwise on principle, and the decisions of the courts in these cases are so well supported by analogous authorities that I have no doubt they will be sustained by the higher courts.

Telephone Companies Common Carriers.

While a telephone company is not, in the strictest and most comprehensive sense of the term, a common carrier, it is now fairly well settled by the authorities that telephone companies, like telegraph companies, are "Common Carriers of News, Messages, or Intelligence." They are not subject to the extraordinary limitations, obligations, and responsibilities imposed by law upon railroads, express companies, and other well-recognized common carriers, nor are they insurers of service, as are some other common carriers, nevertheless their commercial status is so similar to other common carriers that they are regarded in law and treated by the courts as common carriers of news.

The decisions giving to telephone and telegraph companies this legal position are now so numerous as to take the question beyond the field of controversy.

Telephone Companies Also Public Service Corporations.

Telephone companies are also public service corporations, otherwise designated as "quasi-public corporations" or "public utilities"; that is, their duties are of a public nature, although they are organized for private gain, and their stock and property are private possessions. They are, therefore, neither wholly public nor wholly private, but partake of the nature of both, hence the term "quasi-public" as applied to them. Being created for a public use, they are clothed with the extraordinary powers of eminent domain, that is, the right to condemn private property to carry out the purposes for their existence.

As to Duties of and Physical Connection between Telephone Companies.

Telephone companies being common carriers and public service corporations, they are therefore charged with certain duties to the public. They must exercise due care, skill, and diligence in the selection of all their equipment, tools, and appliances for the purpose of rendering good and efficient service and safeguarding the public and their employees from personal injury and their property from damage. They must also exercise such due care, skill, and diligence in the selection of their employees and in the construction, maintenance, and operation of their telephone system to the same end of safety and efficiency. Owing, however, to the delicacy of electrical apparatus and its susceptibility to disturbance and interference by the natural elements and other uncontrollable causes, they are not held in law as insurers for the safe and accurate transmission of messages, nor to that efficiency and continuity of service that may be required of other similar corporations.

But it is not my intention here to go into a consideration of these questions of corporate liability, but rather to discuss the broader questions affecting the independent telephone business as a whole.

As such common carriers and public service corporations, telephone companies are subject to an important rule of law governing all like corporations; that is, they are bound to serve the public with impartiality. They may classify the service according to quantity or cost of service, or by any other reasonable distinctions, for the purpose of graduating rates, but their service must be open to all. They must furnish instruments and service without discrimination to all who are willing to pay the charges and abide by the company's rules and regulations.

Under this law, one telephone company may be, and undoubtedly is, bound in the ordinary course of business to furnish another telephone company with one of its telephones in the other's office or exchange, and render it service in the ordinary business way subject to the reasonable rules and regulations of the company furnishing the service, the same as an individual, or to a telegraph company or other class of business; but such telephone company could not be compelled to furnish its instruments and service to a rival company to be used in competition with itself, either connected up or disconnected with its own system, nor in a special way, to its detriment. The latter is another and a very different proposition from the former and is not embraced within the principle of discrimination nor under the duties of common carriers or public service corporations.

Nor, under the law as it now exists, can one telephone company be compelled to connect up and interchange business with a competing company. As stated by the court in one case, the duty of a telephone company "is to the public and not to another and competing common carrier. One common carrier cannot demand as a right that it be permitted to use a rival common carrier's property for the benefit of its own business.' Another court has said that "one telephone company cannot be forced to afford the facilities which it has provided for its own business to its rival to be used in competition with itself." Still another court has decided "that a reasonable construction of the law does not require a telephone company to furnish to another company connection with its system, to be used by the latter as a part of its own system, upon payment of the ordinary subscriber's tariff." That the courts have no power to enforce physical connection and interchange of business between competing telephone companies is, in my opinion, well established by the authorities. In the language of the court in the Express Company case, "the regulation of matters of this kind is legislative, not judicial." To what extent this legislative power exists, the court, however, expressly stated "that it did not undertake to decide."

That a telephone company, being a public service corporation, clothed with the power of eminent domain and subject to many of the duties of common carriers, is subservient to legislative control, cannot be questioned. Such legislative control, however, cannot invade constitutional rights. The national Congress or State Legislatures may exercise their police powers over telephone companies and may regulate them in the interest of the public welfare, but always within constitutional limitations. The public health and public safety and the public convenience may be subserved by legislative enactment, though not to the extent of overturning vested rights or confiscating property. The language of the court, in a case at hand, states the propositions plainly. "The only limitation upon the legislative power is that the duty imposed must relate to a matter which is within the domain and properly a subject of police regulation, and must be reasonable in its requirements." Telephone companies may be compelled to adopt certain safeguards and appliances to protect the public from accidents, telephone rates may be regulated within certain limits, messenger service may be required for public convenience, but the property and service of one telephone company cannot be taken from it and turned over to its rival without due process of law and just compensation under the constitution.

Act of the constitution of the United States provides: "No person shall be deprived of life, liberty, or property without due process of law; nor shall private property be taken for public use without just compensation."

That the property of a telephone company used in giving service to the general public for hire is devoted to a public use within the meaning of the constitution, is well established by the authorities, both State and federal, and therefore can no longer be a subject for discussion. The only question then remaining and which has not been decided, is "Does a law enforcing a physical connection of the wires of competing telephone companies and compelling them to interchange business constitute a taking of private property within the meaning of the constitution of the United States?" That the property of a telephone company, though devoted to a public use, is private property, I have already stated, and is equally well settled by the decisions. Is there, then, a taking?

Such a taking does not necessarily mean a deprivation of ownership or control over the property; but an appropriation of the use of the property of the one by the other, either in whole or in part, without the consent of the owner, may also constitute a taking under the law. Let us see what an enforced physical connection and interchange of business means.

Compulsory physical connection involves an entrance upon the pole line, conduit, or right of way of one company by the rival company; it means the actual cutting of the wires of the one company by its competitor, and the actual welding or uniting of the competitor's wires thereto; or, in place of this, it means an actual entrance upon the

premises of the one company by the rival company and the placing of its wires into and upon the distributing frame and switchboard of the other company, with separate drop, fuses, and appliances to accommodate that particular circuit. In either case it constitutes an actual physical entrance upon the private right of way or premises of the one company by the other, and the physical fastening of the one company's property to that of the other. This certainly would constitute a taking possession of, and therefore a legal taking of, the property of the one company by the other to its own use. But compulsory connection alone would be of no avail without compulsory interchange of business. This involves still more. It means not only the use of the pole line, wire, drops, fuses, and other physical property taken, but also the appropriation and use of the same and a continuous electric current, the services of the operators, and, in addition thereto, access to the individual telephones of all subscribers, who are under contract with that company, and whom the company has been under considerable expense to procure, and which constitute its most valuable asset. It means also the burdening of the wires and switchboard of the one company with the business of the other and the necessary interference with the business of such company; for while the lines are busy with the one, they cannot be used by the other, and are as effectually barred to the owner as a stranger would be to the property of another. If such devotion of the private property of one to the use, benefit, and profit of another, and a rival in competition with itself, does not constitute a taking of property within the sense of the constitution, it is inconceivable what would constitute such a taking outside of actual larceny.

In three States, I believe, the Legislatures have passed laws authorizing enforced physical connection and interchange of business between telephone companies. In at least one of these States this legislative enactment is backed up by a constitutional provision, but in neither State has the statute been attempted to be enforced or its constitutionality been tested in the courts. Aside from the constitutional objection above raised, I doubt whether such a law would be valid and enforceable between competing telephone companies. For the rule of law is well established, I think, that where the policy of the State is opposed to monopolies, such a law would have to be restricted to telephone companies not in competition with each other. In other words, the law authorizing such physical connection and interchange of business would have to be read in the light of and in connection with the expressed avowed policy of the State, and be constructed in such a way as would not destroy competition and create or tend to create a monopoly.

In two or three railroad cases laws have been held valid enforcing the construction of connecting switches and an exchange of freight between intersecting railroads; but it appears to me that this condition is essentially different from that of two competing local telephone exchanges which occupy the same territory, and whose main asset and stock in trade is their system of subscribers and their rival connecting exchanges. What might be a reasonable regulation with respect to intersecting railroads would certainly be unreasonable if applied to telephone companies, and a careful analysis of the authorities will, in my opinion, bear out my contention.

Illegal Mergers and Combinations.

Illegal mergers and combinations of competing telephone companies were made the subject of a former address, and it is not intended to go into the matter here. Since then many forms of the question have been investigated, the legal authorities collected, and in pursuance with the conclusions reached thereon, several important actions have been commenced in the courts, and other steps taken toward the undoing and nullifying of the effect of these unlawful combinations and bringing violations of the law of this kind to the notice of the proper authorities.

Many important legal questions are still unsolved that should be thoroughly investigated and determined for the good of the general cause. No doubt, too, during the coming winter many bills will be introduced in the legislatures of the various States, injuriously or beneficially affecting the independent telephone interests, that should have the constant and skillful care of the association. The law as it now exists, if fully and persistently invoked, will sustain the integrity of the independent system—the most beneficial and popular telephone service in the land.

CABLE TO BRAZIL.

Consul General George E. Anderson, of Rio de Janeiro, advises that the proposed concession to German interests from the Goverment of Brazil for the laying of a new telegraph cable between Brazil and Europe and South Africa, which has been pending for something over a year, has finally been granted by the Brazilian Government.

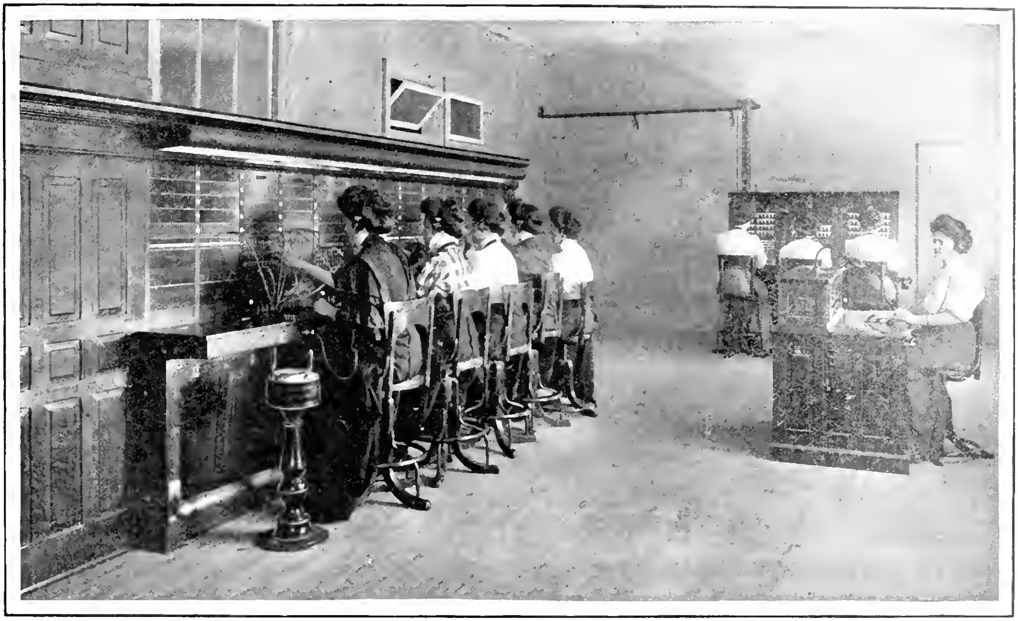
The concession is made to the Felten und Guillaume-Lahmeyerwerke Actien-Gesellschaft, of Mulheim on the Rhine, in a presidential decree, effective October 27. A cable is to be laid from either Pernambuco or Maceio in Brazil, to Teneriffe Island, and, in connection with arrangements to be made with the South American Cable Company, to the west coast of Africa. The concession is granted without time limit, except that the cable must be in operation within three years. The company is to pay the Brazilian Government 10 centimes (about 2 cents) per word on all its business sent or received, and deposits 50 contos of reis (about $15,000) with the Brazilian Government as a guaranty for the performance of its part of the contract. The company must pay for the inspection of its service and accounts by the representative of the Government, give Government business preference over all other, and also give the Government a discount of 50 per cent on its messages. The company also agrees to forward messages from Brazil to Europe for at least 60 centimes (about 12 cents) less than the present cable companies are charging. The provisions as to the forfeiture of the contract, and the regulations under which the service will be given, are those usual to such concessions the world over.

For the operation of this cable there has been formed at Cologne, Germany, the Deutsch Sudamerikanische Telegraphen Gesellschaft, with a capital of 4,000,000 marks ($952,000). The plans of the company, as announced, include the laying of a cable from Germany to Teneriffe, thence to Liberia and German West Africa and German Southwest Africa, and from Teneriffe to Brazil. The German Government is granting a subsidy to the concern, which will guarantee the interest and the amortization of the debentures issued by the company.

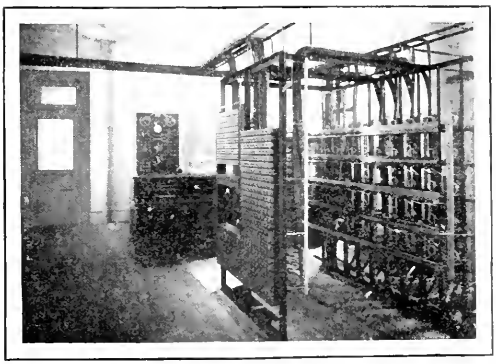
The need of additional cable communication between Brazil and Europe, and especially between Brazil and the United States, is felt more in present rates than in any other phase of the service. The present ordinary commercial rate is about $1.05 per word for messages between Rio de Janeiro and New York City, with charges for other points in proportion. One of the most unsatisfactory phases of the matter is in the fact that this high rate, and other rates proportional for other services, make impossible such an interchange of news and similar matter as is necessary to promote closer relations between the United States and the South American countries concerned.

HARRISONBURG, VIRGINIA, RUSH SWITCHBOARD INSTALLATION.

A complete telephone exchange equipment was installed recently for the Harrisonburg Mutual Telephone Company, of Harrisonburg, Virginia, within thirty days after signing the contract. As is shown in the accompanying illustrations, the equipment includes two 3-position sections of lamp signal common battery multiple switchboard, a 3-section rural switchboard; a combined chief operator's and monitor's desk; a wire chief's desk; a main distributing frame with lightning and sneak current protection; a relay rack and a complete power plant. The present equipment of lines is 480 and the ultimate 1,200.



Harrisonburg, Va., Switchboards, 30 Days After Receipt of Order.



Harrisonburg Terminal Room Equipment 30 Days After Receipt of Order.

The contract was awarded to the Dean Electric Company, of Elyria, Ohio, on October 14, 1908, and the exchange was in operation on November 15. Two weeks of this time was required to get the apparatus on the ground, and the remainder to install it. This is the third emergency common battery switchboard furnished by this company during 1908.

TELEPHONE AND TELEGRAPH POLES AND WIRES AS NUISANCES.

By Emerson W. Read, B. L., L. L. B

Paradoxical as it may seem, it is yet a well known fact in the law that poles erected by telephone, telegraph, or railway people may be nuisances and subject to abatement as such. Generally speaking, poles of such companies are erected by permission of the municipality, resolution of county supervisors, or legislative enactment. Even if resting upon such authority as this, should the poles be erected in such manner as to shut off the light, air, or draught, or obstruct highways or navigable waters, to the injury of the public or private individuals, action may be had to abate nuisance.

As shown, there are two classes of nuisances, public and private. On the distinction between the two the Cyclopedia of Law and Procedure says: "A nuisance is public where it affects the rights enjoyed by citizens as part of the public, that is, the rights to which every citizen is entitled, whereas a private nuisance is anything done to the hurt, annoyance, or detriment of the lands, tenements, or hereditaments of another, and not amounting to a trespass; thus, any unwarrantable, unreasonable, or unlawful use by a person of his own property, real or personal, to the injury of another constitutes a private nuisance. It will thus be observed that the difference between public and private nuisances does not depend upon the nature of the thing done, but upon the question whether it affects the general public or merely some private individual or individuals, and so the same act or structure may be a public nuisance and also a private nuisance as to a person who is thereby caused a special injury other than that inflicted upon the general public, while, on the other hand, the fact that a nuisance injures a great many persons does not make it a public nuisance, where the injury is to the individual property of each person and not to the general public as such."

From this it will be seen that poles erected along high-

ways may be either public or private nuisances. A pole erected outside of the sidewalk line, based in a gutter, causing drained surface water to back up and overflow sidewalk and street, can readily be classed as a public nuisance. A pole carrying a mass of cross-arms, pendant insulators, and a web of wires may render itself a nuisance by shutting off the light to one's windows or roaring and screaming in the customary winds.

The commonest manner by which poles are rendered nuisances is by the obstruction of highways. Poles exceeding the size limits authorized by the franchise have been held nuisances per se. "When the poles erected by a telegraph company are such as are necessary either in size or height, and the right to erect and maintain them is given by the Legislature, so far as they are within that authority they cannot be alleged to be a nuisance or an unlawful obstruction on the street, and to that extent the right to maintain them is legalized; but whenever such right is exceeded either by reason of the size or height of such poles the act is unauthorized, and violates the implied restraint created by the Statute, and is the legal subject of an action of redress." This holding followed an action by the people in New York to restrain a telephone company from erecting poles in a public street, constituting a nuisance and obstruction (People vs. Metropolitan T. & T. Co., 31 Hun 596.)

This contention by municipalities that poles and wires constitute a nuisance must be actually shown before abatement can be had. An action to abate a nuisance is not a proper method of ridding public streets of poles lawfully there but undesirable to the municipality. This scheme was attempted in New Jersey in the case of Brigantine vs. Holland Trust Company No. 2. Basing its authority solely upon its right as a municipality to general supervision and control over public streets, the municipality attempted to restrain the defendant company from stringing wires on poles twenty feet above the street level. The injunction was denied because the municipal authorities could not show that such wires were a serious impediment to travel or general public rights. Another case when the municipality did not have its own way arbitrarily is shown in American U. Tel. Co. vs. Harrison (31 N. J. Eq. 627). "Where there was no reason to believe that the wires as then overhanging the streets did in the slightest degree impede or interfere with the full and free use of the same, the company erecting their poles on private property and hanging their wires at an elevation of twenty-five feet above the roadway, did nothing but what they had a legal right to do. Therefore, the court restrained the corporate authorities from cutting the wires or otherwise unlawfully interfering with them as a public nuisance."

A good instance of the methods that may be legally adopted by municipal authorities in abating nuisances is shown in American Rapid Tel. Co. vs. Hess. An ordinance passed by the city of New York required wires to be placed underground. Should owners of such wires refuse or fail to comply with this ordinance, the Commissioner of Pablic Works, in the exercise of police power, should cause such poles to be cut down and the wires removed. The plaintiff having failed to remove its poles and place the wires in conduits, the poles were chopped down and the wires removed. "Its property was not taken for public use. It was simply removed from the streets, where it had been a nuisance, and the public authorities had the same right to remove it from the streets, doing no unnecessary damage, that it had to remove any other incumbrance therefrom. After the passage of the act referred to, and the building of the subways and the notice to the plaintiff, it had no right longer to maintain its poles and wires above the surface of the streets. They were then there without authority, and thus became a nuisance and hence the public officials had the right to remove them."

A Western case of wide importance arose over a San Francisco ordinance prohibiting companies from suspending electric wires over or upon the roofs of buildings. Judge Sawyer said in his opinion (Electric Impt. Co. vs. City and County of San Francisco, 45 Fed. Rep. 593): "That the stretching of these wires over buildings in the manner practiced, as shown by the evidence, no one, I think, can doubt after reading the affidavits, is extremely dangerous, both as being to originate fires, and as obstructions to the extinguishment of fires otherwise originated. Indeed, the danger is a matter of common knowledge. We might almost as well require strict proof of the danger of storing gunpowder, or dynamite, in, under, upon, or about our houses. The danger is of a character cognate to that of gunpowder. Should a raging fire occur, originated by the electric current or otherwise, these dangerous wires might so obstruct the efforts of the firemen, to extinguish it, as to result in the destruction of the entire city. It is certainly competent, under the police powers of the State, to suppress such dangerous erections, in the interests of the common safety of the community . . . . They (electric wires) have no more right to be there than gunpowder. The only wonder is that owners of buildings in view of the recognized danger will permit their use for such purposes. . . . . I regret to be obliged by this decision to affect so seriously the interests of the enterprising parties who are endeavoring to supply our citizens with electricity for the various purposes to which it is now applied. But I cannot decline to administer the law as I find it, for the safety and security of the lives and property of the citizens of San Francisco."

EFFECT OF SINGLE-PHASE ELECTRIFICATION ON TELEPHONE LINES.

Single phase electrification affects telegraph and telephone systems whose wires lie parallel with and in close proximity to the New Haven electric railroad. The corrective for this disturbance has proved to be simple and not costly. Briefly described, it consists of compensating transformers whose secondaries are a part of the telegraph and telephone wires and whose primaries receive their voltage from pilot wires strung on the same cross-arms as those bearing the telegraph and telephone wires, and thus having impressed upon them the same voltage, by electro-magnetic induction, as the telegraph and telephone wires. The transformer secondary voltage is approximately equal and opposite to the induced voltage on the telegraph and telephone wires and thus constantly compensates for it throughout all ranges of induction due to the single-phase wires.

An interesting commentary on the efficacy of the compensating transformer is that its use obviated the necessity of any change in the physical location of the telegraph and telephone lines within the zone of induction, and has thus been the means of removing what at first was rightly considered a very offensive attribute of the single-phase system.—Extract from "The Log of The New Haven Electrification," read by W. S. Murray, December, 1908, meeting A. I. E. E.

Electricity is produced by light acting upon rubidium, potassium, and the liquid alloy of potassium—sodium. Under the action of ordinary and ultra-violet light the electro-positive metals lose a negative charge of electricity, the effect being most pronounced on the three first-named. Before the Physical Society of London, Dr. Fleming recently showed that a difference of potential of from 0.4 to 0.8 volt exists between a platinum and a sodium potassium terminal when the latter is illuminated by a powerful beam of light. This photo-electric effect is largely dependent upon the color of the light, and especially that absorbed by the alloy. Potassium is most active with violet light, and zinc with the ultra-violet, which are likewise the waves emitted by these same metals when heated or otherwise made radiant.

CURRENT COMMENT

Fuel alcohol from one bushel of white potatoes produces one brake-horsepower in an engine the yield being 0.8 pint. A bushel of corn yields 2.5 pints.

The force of the tides near the mouth of the Elbe River, Germany, is to be used to produce electric power for factories. A capital of $750,000 has been raised and several buildings completed at Cuxhaven.

An electric insect destroyer has been patented by two Oklahoma inventors. It consists of a frame upon which are mounted a positive and a negative electric wire. It is surmised that the luckless fly will be electrocuted when it lights upon the frame.

The cost of electric heating for domestic purposes is on a par with gas at one dollar per thousand feet if the current charge be two and one-half cents per kilowatt hour, according to calculations presented by Mr. Max Lowenthal, at a recent discussion on electric heating.

Automatic telephone service for Honolulu is planned by the Hawaiian Telegraph & Telephone Co., which has acquired the franchise of the Standard Telephone Co. This company maintains wireless telegraph communication between the various islands, and is experimenting with the wireless telephone.

A Hawaiian hydro-electric plant is planned to utilize the 900-ft. head that will be available with the completion of the Nuuano Valley Dam, near Honolulu. The next Legislature meeting in February, is expected to make appropriations for a 12,000 horsepower plant to furnish power for pumping water and lighting Honolulu.

Silundum or solidified carbon is now employed as the heating element for electric heating devices. Carbon in any shape is electrically heated in the presence of the vapor of silicon to produce it. Its resistance to an electric current is three times that of carbon and can be heated to 1,600 degrees C. without oxidation. The material is very hard and is acid proof.

A hydraulic ram installation at Sunnyside, in the Yakima Valley, Washington, consists of eleven 6-in. rams, operating under a fall of 37.6 feet and a lift of 143.11 feet from the rams. Under these conditions, with a consumption of 5.11 cubic feet per second of drive water, 1.15 cubic feet of water per second is lifted to the point of delivery. This is stated to be a higher efficiency than has been attained by a water wheel directly connected to a centrifugal pump.

The Owens River aqueduct, to supply Los Angeles, California, with water from the Sierra Nevada Mountains, is well under way. Two electric power plants have been completed, and a telephone line has been strung the entire length of the aqueduct. The Elizabeth tunnel is being driven from both ends and from the bottom of a 183-ft. shaft. The cement plant will be in operation about January 15th. It is hoped that the work will be done for less money and in less time than was named by the city's engineers.

A telephone system is being installed on the Santa Fe Railroad's main line between Chicago and Los Angeles for the handling of train orders and other business incident to train movements. The work has commenced in Kansas. This new arrangement is not to succeed the telegraph, but merely to facilitate the work. The expected benefit to be derived from the use of the phones is that they will greatly facilitate the handling of train orders, for an average rate of forty words a minute is all that can be sent over the key, while with the telephone a man can send three or four times that amount with ease and accuracy.

Electric smelting of zinc is now being successfully accomplished at the works of the Canadian Zinc Company, at Nelson, B. C. Electric power is generated at Benning Falls on the Kootenay River and transmitted to the plant, whose present capacity is 10 tons daily.

The proper hardening heat of steel tools may be determined by the fact that the property of magnetic attraction is lost at this temperature. An English patent provides for a magnetized support which allows the steel to drop into a brine bath when the proper heat is reached.

Wireless telephony over 200 miles between Plymouth and Jamaica, L. I., was claimed by Mr. A. S. Stein, of the National Electric Signaling Company, in a talk on "Recent Apparatus for Wireless Telephony," before the Boston section of the American Institute of Electrical Engineers, recently.

The bravery of a telephone girl who stayed at her switchboard to notify the fire department that the board was ablaze, probably lessened the damage to the San Rafael, California, exchange of the Pacific Telephone & Telegraph Co. The fire was caused by short circuited wires, and, in addition to cutting off the service for a day, it resulted in several hundred dollars' damage. The operator was Miss Pauline Euler.

An electrically propelled fire boat has been recently built to protect the wharves of Chicago. The main pumping and power machinery consists of two 660 horsepower Curtis turbines connected to 200 kilowatt direct current generators and two-stage centrifugal pumps. In going to the fire, the pump impellers run dry. Complete control of all motors is had from the pilot house, and on a test run the captain easily handled the boat without the engineer's aid.

Telephone train operation has been endorsed by the American Railway Association, at the annual meeting just concluded, and was agreed upon after numerous severe tests. [illegible] one of the features of the new plan will be [illegible] domination by the railway telegraphers' union. The Burlington road was the pioneer in the use of telephones, and other roads are now installing the necessary plants. It is predicted that the use of telephones will soon become general on [illegible] railroad systems.

Fishing by telephone has been invented in Norway according to Consul Louis Goldschmidt, of Nantes, France. A microphone, the role of which consists in amplifying subaqueous sounds, is shut up in a thin, water-tight steel box and kept in constant communication by metallic wires with a telephone receiver installed on the fishing boat. It is stated [illegible] the fisherman is always informed of the approach of [illegible]. Moreover, it is said that each kind of [illegible] in the water [illegible] particular sound. Thus the approach of herring is signalized by a sort of whistling; the codfish announces its arrival in the neighborhood by a sort of grunting.

Electricity in Japan is the subject of an article in a Japanese paper, transmitted by Vice-Consul E. G. Babbitt, of Yokohama, from which the following resume has been made. The authorized capital of electric undertakings in 1903, 28,500,000 yen ($14,193,000), of which 24,000,000 yen ($11,952,000) was paid up, had risen to 138,000,000 yen ($68,724,000) in 1907, of which 87,500,000 yen ($43,575,000) was paid up. The electric works undertaken chiefly represented lighting and tramways. The number of lights supplied in 1903, 365,000, had increased in 1907 to 859,143. Tokyo and Osaka require, each, 100,000 lights. Electric tramways show equal development. In 1903 the mileage was 38, which rose to 119 in 1907, and will be largely added to by construction during the present year.

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TELEPHONE . . . . KEARNY 918

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

In Permanent Quarters.

Since the offices in the Technical Building were rendered untenantable by fire in November, of last year, the "Journal of Electricity, Power and Gas" has temporarily occupied the store at 155 New Montgomery Street, in the Greenwood Building. This week we are moving to permanent quarters in the Atlas Building, 604 Mission Street, San Francisco, and will occupy the entire ninth floor. Out-of-town readers of the "Journal" may have their mail addressed to these offices and are invited to make them their headquarters while in San Francisco. This is a fireproof building, one of the few that withstood the fire and earthquake of 1906.

Convenience in Telephoning.

Considering convenience as the chief cause of the telephone's popularity, anything that will promote ease and rapidity in its use should be fostered. Of even greater importance than good "central" service in placing outgoing calls and facilitating the movement of incoming messages, is the advantageous position of a subscriber's instrument. This should be placed where it will be most easily accessible, the importance of this factor being of more weight than the low cost of installing the set. The injudicious location of the telephone may undo all the good work of the solicitor in originally getting the business. By making telephoning easy, the subscriber will be a permanent one.

Underground Telephone Construction.

Twenty years ago, telephone conduit construction was in disfavor because of the difficulties of operation. To-day, these difficulties, chief among which are induction and retardation, have been overcome and such construction in many cities is now prescribed. Notwithstanding that the case is thus one of "Hobson's choice," nevertheless in many instances it is found much to the company's advantage to place the cables underground. This eliminates any danger of line destruction by storms and removes the cost of defense against expensive law suits for personal injury. Furthermore it withdraws any grounds for the popular complaint against aerial wires and poles which interfere with fire fighting and street traffic. Incidentally, it effectually does away with the nuisance of [illegible] who do not recognize the vested rights of the owners of telephone poles and wires in the street. It also eliminates all controversy as to the right of [illegible].

Although the initial cost of conduit work is high, maintenance is correspondingly low and its life is longer than that of any other portion of the plant. The usual allowance of a fifty-year life on the book value gives a depreciation charge of [illegible] per cent. In laying out a system it is customary to anticipate reaching capacity [illegible] fifteen years to come, as that is the average life of most telephone apparatus.

In entering a settled community, where there is to be a large number of parallel wires, there can be but little question as to the superiority of conduit construction.

BOOKS RECEIVED.

"A, B, C of the Telephone." Second and revised edition A practical and useful treatise for students and workers in telephony, giving a review of the development of the industry to the present date, and full descriptions of numerous valuable inventions and appliances, together with very many illustrations, diagrams, and tables. By James E. Homans, New York. 335 pages, 266 illustrations. Theo. Audel & Co., 1901. For sale by the Technical Book Shop, 111 New Montgomery St., San Francisco.

This is an elementary treatise prepared for the beginner and general reader, all theoretical and abstruse descriptions being omitted. The book contains twenty-nine chapters, each one thoroughly covering some one feature of the subject.

After a brief historical and descriptive introduction, the author briefly outlines the theory of sound and the principles of electricity Continuing, he describes various switchboard equipments, party lines, and private telephone lines Considerable space is devoted to line construction and wiring, and brief accounts are given of the micro-telephone and wireless telephony. The concluding chapter contains some useful definitions and hints on telephone management

The book can be readily understood by the non-technical reader without previous knowledge of electricity In several instances, illustrations of antequated apparatus are given and there are a few typographical errors, such as designating the section on wireless telephony as "Chapter Thirty-eight" instead of twenty-eight But on the whole it is an excellent book to be put in the hands of the beginner.

"New Business Report for 1909." Published by Frank B Rae, Jr., 74 Cortland St., New York City, for the National Commercial Gas Association 136 pages, well illustrated, handsomely printed and bound Price $3.00 For sale by Technical Book Shop, 111 New Montgomery St., San Francisco.

"It consists of contributed articles from men successful in cultivating an art of great usefulness Here will be found the experiences of men who have not been content to follow precedent, but who have had sufficient courage to apply a little science and some brains to the improvement of an every-day service" The volume is edited by Mr George Williams and includes the following articles: "Initiative," Elbert Hubbard; "Success in Salesmanship," Charles N Crewdson; "The Solicitor's Opportunity," A B Leach; "To the Young Man," Leslie M Shaw; "The Right Business Spirit," Waldo Pondray Warren; "Commercial Plans Require Judgment," Alex J Campbell; "New Business Don'ts," M. C. Osborn; "The Newspaper as an Ally," Charles M. Cohn; "The Necessity of a Higher Standard," C. W. Hare; "Advertising, Printed and Personal," La Forest F. Blyler; "Promotion Not Competition," George Williams; "Illuminating Engineering as a Business Getter," E. Leavenworth Elliott; "Show Window Illumination," T J Litle, Jr.; "Hints for Arranging a Show Room," C E. Moore; "Organization of New Business Department," E. N. Wrightington.

GOLF TOURNAMENT AT DEL MONTE.

The electrical jobbers of the Pacific Coast have a very pleasant habit of meeting at irregular intervals, for getting business volts and amperes, for the time being, and engaging in sports after the manner of the ancients in the prosperous days of Greece and Rome Just such a meeting will be held at Del Monte, California, on January 16th, 17th and 18th, when the jobbers from Seattle, Portland, San Francisco and Los Angeles will gather at the Hotel Del Monte and a most desperate struggle will take place for supremacy in golf, the

national game of Scotland A preliminary round will be played to establish the necessary handicaps after which friendship will cease and blood will tell The prize is a handsome silver cup and the contest between the delegations from different cities promises to be a warm one

PERSONALS.

A L Havens, the Los Angeles representative of Pierson, Roeding & Co., of San Francisco, is in town

Edward F R Vail, president of the Home Telephone Co., of Santa Barbara, California, was in San Francisco this week

B B Becket, formerly engineer with the Ocean Shore Railway, and recently returned from Central America, has joined the sales force of the Electric Storage Battery Co

I S Utley, in charge of the incandescent lamp department of the Western Electric Company, San Francisco, has returned from a two weeks' vacation trip to Riverside, California

F J Koppitz, sales engineer with the San Francisco office of the Western Electric Co., was married to Miss Maude Davis, of San Francisco, on January 2, 1909, and is now receiving the felicitations of his friends

C W Scott, manager of the San Francisco office of the H W Johns-Manville Company, will leave for the East, on January 23d, to attend the regular convention of managers of his company, which will be held in New York early in February

TRADE CATALOGUES.

Bulletin No 82 from the Wagner Electric Manufacturing Company, of St Louis, Mo., is devoted to the new Wagner Polyphase Motors It contains a frank discussion of the relations between ratings and overloads and between starting torque and efficiency

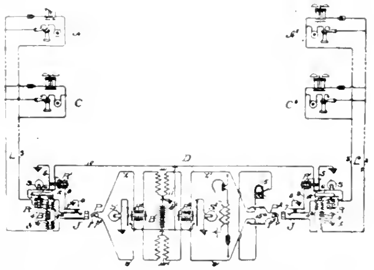
Bulletin No 15 from the Welsbach Company, of Gloucester, N J., is a reprint of an excellent paper on "Modern Gas Lighting," read by Mr M G Whitaker before the architects and builders of Detroit, Mich

In pamphlet No 3715, just issued by the General Electric Company, are described mercury arc rectifiers for telephone battery charging The points of superiority which this outfit is claimed to have over the general motor-generator sets, rotary converters, and electrolytic rectifiers for charging central telephone batteries, are reliability, freedom from line disturbances, high efficiency, low first cost, low cost of maintenance, simplicity of operation, noiseless operation, and economy of floor space The pamphlet contains a detailed description of the outfit, with connection diagrams and dimensions

PATENTS

TELEPHONE SYSTEM. 907,224. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard & Supply Company, Chicago, Ill.

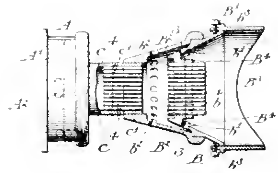
In a telephone system, the combination with a telephone line, or a cord circuit to connect therewith, a relay and a battery permanently connected in the line, the said



relay being under the control of the subscriber at all times, a ground tap adapted to be connected with the talking circuit and controlled by said relay, and telephonic apparatus associated with the cord circuit having its operation affected by current flowing over a circuit formed of a portion of the said talking circuit and said ground tap.

DEVICE FOR TRANSMITTING SOUND-WAVES. 907,320. Arthur Dare, Philadelphia, Pa.

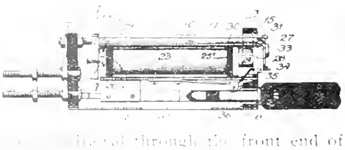
A telephone transmitter comprising two connected conical chambers, the first of which is adapted to act as a mouthpiece, and the second as an expansion chamber, the first chamber being provided with annular openings communicating with the second chamber, and the latter having similar open-



ings admitting communications from without, a series of non-resonant tubes interposed between the chambers, a pipe leading from the second chamber to a box containing the diaphragm and its mechanism, a series of non-resonant tubes contained within said pipe and means including a lever and connecting link for moving the chambers and consequently varying the distance between the non resonant tubes.

TELEPHONE-DROP. 907,062. Tiodolf Lidberg, Chicago, Ill., assignor to Swedish American Telephone Company, Chicago, Ill.

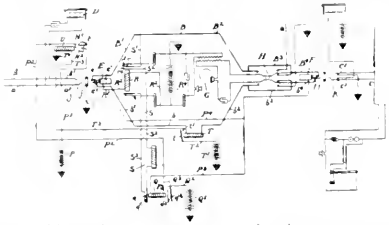
In a telephone-drop, a cylindrical coil-casing open at [illegible] electromagnet comprising a coil arranged for



[illegible] through the front end of said casing [illegible] separably [illegible] thereto and shutter [illegible] to said casing and controlled by said [illegible]

PRIVATE-BRANCH-EXCHANGE TELEPHONE SYSTEM. 906,602. Frank Arens, Cincinnati, Ohio.

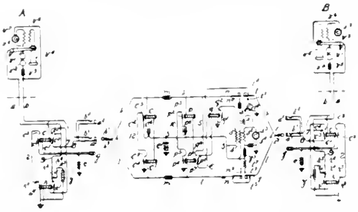
In a private-branch-exchange system, in combination with the cord mains, the answering jack and plug, the calling jack and plug, and the supervision signal, a shunt circuit connecting the mains, said circuit being interrupted by two spring contacts, the first of said spring contacts being normally open, and the second, normally closed, relays for



actuating said spring contacts, a circuit to energize the first relay adapted to be closed by the insertion of the answering plug, a circuit to energize the second relay adapted to be closed upon the operation of the supervision signal, a supplemental circuit connected with the second relay and terminating in the answering plug, said circuit being normally open, and a spring contact adapted to close said supplemental circuit, said spring being operated by said second relay.

TELEPHONE SYSTEM. 907,581. Alfred H. Dyson, Chicago, Ill., assignor to Milo G. Kellogg, Chicago, Ill.

An electric signaling system comprising a circuit extending from one station to a second, a source of current included in said circuit, a signal associated therewith, an electro-magnet normally under the control of the first station for causing the display of said signal, a second electro-magnet for destroying said control, plug and jack



contacts associated with said circuit, means for completing a talking circuit through said plug and jack contacts, an energizing circuit for said second electro-magnet local to said second station and including talking contacts of said plug and jack and being normally open at a second point, and means under the control of the first station for closing said energizing circuit at said latter point.

WATER-WHEEL. 906,754. Arnold Tschirgi, Sheridan, Wyo.

The combination of a dam provided with a wheel space, end plates arranged within the wheel space, the end plates being spaced from the walls thereof and provided with flanges which are secured thereto, a bulkhead supported upon the end plates, a wheel mounted between the end plates and provided with swinging buckets, a circular plate slidably mounted upon one of the end plates, a ring upon the circular plate, links connecting the ring to the buckets of the wheel, and means for moving the circular plate into a concentric or eccentric relation with the axis of the wheel, the dam being provided with means for delivering water to the wheel and discharging it therefrom.

INDUSTRIAL

A NEW SPEED COUNTER.

The Veeder Manufacturing Company, of Hartford, Conn., has just put on the market a new speed indicator, which is quite unique in design, being entirely different from anything else for the same purpose now on the market. It uses for the registering apparatus one of the revolution counters, so familiar to all users of counters, and which requires a complete revolution of its shaft to register one unit. The new indicator is capable of being run up to 10,000, which is capacity enough for all ordinary cases.

The limit of speed for which the instrument is recommended is about 5,000 revolutions per minute. It can be used at higher speeds, but the wear is much greater at excessively high speeds.

To determine the actual number of revolutions, the reading of the counter must be taken before starting the count, as no setback arrangement is provided for bringing the register back to zero. This saves the bother of setting the counter back and is not inconvenient; any setback now made renders the instrument inaccurate. It is a very easy matter to jot down the reading of the register at the beginning and at the end of the period for which the count is taken, and the difference between the two readings gives the count for the period desired. The counter works equally well in either direction. When run one way, it subtracts; when run the other, it adds. In either case the difference of the readings gives the actual count.

The counter is extremely compact and weighs but a few ounces. It is comfortable to hold in the hand and its readings are reliable because of the direct reading index.

Where it is desirable to use a counter in connection with electrical machinery, the rubber tip shown is provided, which effectually insulates the counter from any current there may be in the machinery

THE NEW ANNUNCIATOR.

A valuable improvement in the well-known magnetized needle form of annunciator is now being placed on the market.

In the old type of instrument, false indications not infrequently resulted because the needles came within the influence of the magnet cores while vibrating after being reset.

In the new type, the needles are attached to the face-plate instead of to the setback rod. A V-shaped slot in the setback bar engages a lug on the needle which passes through the plate, thus returning the needle to its normal vertical position. No resetting oscillation is possible, because the V-shaped slot brings the needle to immediate rest

Another important feature of the new annunciator is that raising the setback rod does not impart to the needles any general movement. In early types, where resetting "jiggles" all the needles, a heavily charged magnet core often would re-attract a needle, causing false indication

The bell mechanism is attached to a frame hinged to the case. This allows the testing of the bell or lines to be done without the removal of the bell from the case. The case is plain with round corners, well finished, and attaches to the wall with four screws. The terminals have lugs to prevent the wire slipping and are soldered to the wires from the magnet coils.

A telephone terminal is provided on the type "C," which enables telephones to be connected to the system, and this is accomplished with no more wiring than that used for the ordinary annunciator. If the building has been wired, a telephone can be substituted for the push button at any outlet and a telephone for the attendants' use placed in the same room with the annunciator. Where the householder can get such convenient service so inexpensively, the electrical contractor can of course find profitable business."

This new annunciator is also made with the operator's set attached to the case. There are a number of different types of cases as well as self-setting and elevator styles. It has been named the "Hub" and is manufactured by the Electric Goods Manufacturing Company, Boston, Mass.

SUPPLY DEPARTMENT CONFERENCE GENERAL ELECTRIC COMPANY.

On January 4th, 5th and 6th the Pacific Coast Supply Department of the General Electric Company held its annual meeting at the Fairmont Hotel, San Francisco, for the discussion of subjects of interest to that department The meeting closed with a dinner at the Fairmont Hotel on the night of January 6th, at which Mr T E Bibbins, manager of the Department, presided in his usual happy manner

The meeting was one of the most successful in the experience of that company and the many brilliant talks at the concluding dinner indicated the possibilities which can be developed in the supply man under proper leadership

In addition to the Pacific Coast force of the department there were present Mr F G Vaughen and Mr G C. Osborne of the Eastern organization, and their presence aided materially in making the convention a success.

LIMIT OF SAFETY IN STORED COAL.

The Coal Department of the Arthur D. Little Laboratory, Boston, has found instances where a small coal pile cooled down after being as hot as 165 degrees Fahrenheit. This was probably a rare occurrence, as the temperature generally increases rapidly as the coal heats up above 150 degrees, and there is no doubt but that when 212 degrees Fahrenheit is reached, the coal must be moved or some steps taken to cool it, in order to prevent fire Temperatures as high as 485 degrees Fahrenheit have been observed, and at this temperature the coal ignited when exposed to the air

GROUND TROUBLE.

A Seattle telephone user has been bothered by the ringing of his telephone bell whenever the electric light was turned on. Investigation showed that the fixture wiring had been grounded to a gas-pipe, and the telephone had been grounded to a water-pipe, enough current being picked up to ring the telephone bell. The trouble was cleared by removing the telephone ground from the water-pipe

The examination will consist of: Mathematics, materials, calculations, drafting, and training and experience. Competitors must possess knowledge that will enable them to design the engines and all machinery in light-house tenders

APPROVED ELECTRICAL DEVICES

CONDUIT BOXES.

"Pratt" pressed-steel, square type outlet boxes with covers, galvanized or enameled finish. Approved Dec. 14, 1908. Manufactured by

Pratt-Chuck Co., Frankfort, N. Y.

CONDUIT BOXES, FLOOR OUTLET.

"T & B" Watertight Floor Outlet. A cast-iron box with a brass plate and cap. Hubbell plug and receptacles 10 A., 250 volts. Approved Dec. 7, 1908. Manufactured by

Thomas & Betts Co., 299 Broadway, New York, N. Y.

FLEXIBLE CORD, PENDANT.

Marking: Two green cotton threads running parallel, with wire between the rubber insulation and braid. Approved Dec 18, 1908. Manufactured by

Bishop Gutta-Percha Co., 420 E. 25th St., New York, N. Y.

LAMP ADJUSTERS.

Harley's No. 1 Electric Light Holder. Two sliding wooden strips having the upper strip secured to a mounting block by a ball and socket joint and with the flexible cord running in a groove cut on the inner surface of the lower strip. Approved Dec 18, 1908. Manufactured by

Harley Machine Co., 92 Hayden Ave., Springfield, Mass.

MISCELLANEOUS.

Mercury Arc Rectifiers for converting alternating to direct currents; outfits supplied for alternating-current circuits of 110, 220, and 300 volts, with direct current capacities up to and including 30 amperes. Also mercury arc rectifier panel for moving picture machines, 220 volts. For telephone battery service this apparatus may include G. E. type H transformer of unity ratio, to be inserted as an insulation between alternating and direct current circuit grounded neutral and ground return of the telephone system. Compensating reactance case must be mounted on base of slate or other non-combustible insulating material when installed on floor or wall of combustible material. Approved Dec 18, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

"G. E." Buzzer, alternating-current circuit, 2 A., 125 volts. For use only in series with incandescent lamps to indicate when lamps are left with current on. Approved Dec. 7, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

RECEPTACLES FOR ATTACHMENT PLUGS.

G. E. cleat concealed and flush types of receptacles with "pull-off" attachment plugs, 6 ampere, 250 volts. Cat. Nos. 49488-49490, inclusive. Approved Dec. 17, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

Ten amperes, 250 volts. Surface, cleat type, Cat. Nos. 5512-5514, inclusive. Surface, concealed type, Cat. Nos. 5426-5428, inclusive. Surface, moulding type, Cat. Nos. 5540-5542, inclusive. Surface, fielding, Cat. Nos. 5560-5584-5585. Flush wall type, Cat. Nos. 5415-5418, inclusive; 5443-5446, inclusive; and "Polarity," Cat. No. 5565. Floor box type, Cat. Nos. 5506-5508, inclusive; 5469-5471, inclusive; and 5561-5563, inclusive, when installed in approved wall boxes in side walls, or when entirely enclosed in approved water-tight floor outlet boxes. Approved Dec. 15, 1908. Manufactured by

Harvey Hubbell, Inc., 35 Organ St., Bridgeport, Conn.

SWITCHES, KNIFE.

All capacities, 250 and 600 volts, with or without fuse extensions. Approved Dec. 15, 1908. Manufactured by

E. G. Bernard Co., Troy, N. Y.

ROSETTES, LINK FUSE.

"Bryant, Jr." 2 amperes, 125 volts. Cleat type, Cat. No. 1501. Concealed type, Cat. No. 1502. Conduit box type, Cat. No. 368. Also "Bryant" combined cleat and fusible rosette, Cat. No. 965. Approved Dec. 28, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

ROSETTES, FUSELESS.

"Bryant," 3 amperes, 250 volts, KP style. Cleat, concealed and moulding types, Cat. Nos. 1499, 1710-1497. "Junior" style, cleat, concealed, conduit box and moulding types, Cat. Nos. 1999, 297, 369, 299. Also cleat type, Cat. No. 869, with porcelain sub-base, Cat. No. 1247. Approved Dec. 18, 1908. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

SOCKETS, STANDARD.

Brass shell, key and keyless, Cat. Nos. 157, 0157, 357, 0357, 457, 0457, 557, 0557, and 460 to 465, inclusive, with metal keys; and "Snap Cap." Cat. Nos. 440 to 445; also all above types with shade-holders attached. Approved Dec. 29, 1908. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

G. E. brass shell, key type, lock socket, Cat. No. 58951, 50 C. P., 250 volts. Sockets with revolving screw shells from which lamps cannot be removed without access (by means of special keys) to certain stops on the interiors. Approved Dec. 2, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

RECEPTACLES, STANDARD.

"P & S" Wall Sockets, 3 amperes, 250 volts (keyless), and 50 C. P., 250 volt (key), brass shell, Cat. Nos. 387, 0387, 455, 456, and 467, 468, 469 with metal keys. Porcelain shell, Cat. Nos. 2371, 02371, 237, 0237, 247, 0247. Approved Dec. 30, 1908. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

SWITCHES, PUSH-BUTTON FLUSH.

"Marshall" Push-button flush switches, single-pole and three-way, 10 A., 125 volt, 5 A., 250 volt, Cat. Nos. 1001, 1003. Double-pole, 10 A., 250 volts, Cat. No. 1002. Approved Dec. 7, 1908. Manufactured by

Marshall Electric Co., 301 Congress St., Boston, Mass.

SWITCHES, SURFACE SNAP.

"G. E." with or without indicator, closed or slotted bases. Single-pole, 3 A., 250 V.; 5 A., 125 V.; Cat. Nos. 59873-74, 60294-95. 5 A., 250 V.; 5 A., 125 V.; Cat. Nos. 60950-53. Double-pole, 5 A., 250 V.; Cat. Nos. 60950-53; 10 A., 250 V.; Cat. Nos. 60451-54. Three-way, 3 A., 250 V.; 5 A., 125 V.; Cat. No. 60955; 5 A., 250 V.; 10 A. 125 V.; Cat. Nos. 60455-56. Four-way, 2 A., 250 V.; 5 A., 125 V.; Cat. Nos. 60458-59. Two-circuit, 2 A., 250 V.; 5 A., 125 V.; Cat. Nos. 60460-63. Three-circuit, 2 A., 250 V.; 5 A., 125 V.; Cat. Nos. 60464-07. Approved Dec. 7, 1908. Manufactured by

General Electric Co., Schenectady, N. Y.

"Perkins" three-pole snap switches with Vulcabeston commutators. 15 A., 125-250 V., Cat. Nos. 2025, 2026, 2045, 2046. Approved Dec. 16, 1908. Manufactured by

Perkins Electric Switch Manufacturing Co., Bridgeport, Conn.

SWITCHES, SURFACE SNAP, SUB-BASES.

"Arrow E" porcelain sub-bases for surface snap switches. Cat. Nos. 6330, 6331, 6332, 6335, 6336, 6337, and 6340. Approved Dec. 18, 1908. Manufactured by

Arrow Electric Co., 619 Capitol Ave., Hartford, Conn.

NEWS NOTES

TELEPHONE.

MILWAUKIE, ORE.—This place will have a telephone system soon. No names mentioned.

MONROE, WASH.—A move is on foot to extend the line of the Independent Telephone Company to Cherry Valley.

EUGENE, ORE.—Negotiations are in progress with the Home Telephone Company of Portland for the establishment of that system here.

TULARE, CAL.—The Pacific Telephone & Telegraph Company has taken over the system of the Home Telephone Company, of this county.

FARMINGTON, UTAH.—The Davis County Independent Telephone Company has organized and they expect to cover all of Davis County.

BELLINGHAM, WASH.—It is announced that $50,000 will be expended by the Home Telephone Company in the extension of its service lines in this city.

WINNEMUCCA, NEV.—The residents of Quin River Valley have subscribed the sum of $2,950 towards the building of a new telephone line from Haviland's Station to McDermit.

BUTTE, MONT.—The Inter-Mountain Construction Company expects to do considerable work this spring, and will install new boards in Helena, Deer Lodge and other points.

MT. VERNON, WASH.—The citizens of this city have signed up with the Farmers' Mutual Independent Telephone Co. of Everett, Wash., to use their service from the first of the year.

MODESTO, CAL.—The Sylvan Rural Telephone Company is completing the construction of its lines in and around Modesto, and expect to give rural service in the next thirty days.

GOLDENDALE, WASH.—The Goldendale Telegraph and Telephone Company will place a new switchboard in their exchange immediately, and otherwise thoroughly overhaul their system.

BERKELEY, CAL.—Manager F. F. White, of the Pacific States Telephone & Telegraph Company, in Berkeley, has announced that the company will lay more than 100,000 feet of cable in that city in the spring.

BOISE, IDAHO.—The Independent Long Distance Telephone Company is contemplating overhauling its exchanges at Nampa, Payette and Weiser and putting in new common battery switchboards this spring.

ANACORTES, WASH.—W. J. Phillips, division superintendent of the Pacific Telephone Company, with headquarters at Portland, was in the city recently mapping out improvements that the company proposes to make in the near future.

ONTARIO, ORE.—A telephone company, to be known as the Farmers' Mutual, was organized recently by the farmers living about Fruitland. B. F. Tussing is president of the company and H. E. Smith secretary. The plan is to install the system at once.

TENINO, WASH.—Negotiations have just been completed which will combine the telephone exchange, the Light & Power Company and the water works under one general office and plant roof, under the ownership and management of W. Dean Hays and S. W. Fenton. The plans for the consolidation of the plants and management include extensive improvements to all three systems.

ANACORTES, WASH.—The Farmers' Mutual Independent Telephone Company, of Everett, Wash., have purchased a new common battery multiple switchboard for this station. This board was shipped the first of the year and will be in operation about the first of February.

SILVERTON, ORE.—The Interurban Telephone Company have placed the order for a new multiple switchboard with the Dean Eelectric Company, Elyria, Ohio. This board will soon be shipped, and the Interurban Telephone Company expects to give as fine service as can be had in the State of Oregon.

TONOPAH, NEV.—An agreement has been reached whereby the Postal Telegraph Company will use the lines of the Southern Nevada Telephone & Telegraph Company, the former company having now opened offices in this city. The Postal Company will soon be forwarding messages to the Coast.

SAN FRANCISCO, CAL.—Joseph Harris, of Chicago, president of the Automatic Electric Company, and who is now in this city, states that the installation of 65,000 automatic telephones for the Home Telephone Company in San Francisco, will begin in March. Mr. Harris states that 15,000 telephones, switchboards and other appliances representing an investment of $1,000,000, are now on their way to this city, an additional 50,000 telephones to be shipped later. The Home Company of this city will erect long-distance lines along the Coast to parallel the lines of the Pacific Telephone & Telegraph Company. Harris announces that the Home Company will be ready to begin operations by the middle of the year.

ILLUMINATION.

CANBY, ORE.—A light and power franchise has been granted to M. J. Lee.

LAPWAI, IDA.—J. W. Henderson, a local business man, is preparing to install an electric light plant.

LEWISTON, IDA.—W. H. Bomke of Spokane has asked the city council for an electric light franchise.

VANCOUVER, B. C.—The North Vancouver Gas, Heat & Gas Power Company, Ltd., has asked for a franchise.

BREMERTON, WASH.—Peninsular Light & Power Company submitted an ordinance for a franchise for electric light and power plant.

HOQUIAM, WASH.—It is announced that the Grays Harbor Railway & Light Company will soon replace its wooden light poles with steel and will install cluster lights.

MANILA, P. I.—At a recent session of the Municipal Board of the city of Zamboanga it was indicated that there is a strong possibility of the immediate installation of a modern electric lighting plant in that city.

QUINCY, CAL.—The permanent machinery to be installed in the plant of the Indian Valley Electric Light & Power Company at Greenville has arrived and will be established as readily as weather conditions will permit.

MODESTO, CAL.—The bid of $225 of the La Grange Light & Power Co. for a franchise to erect and maintain poles and wires for the transmission of electrical power for light, heat and power, has been accepted by the City Council.

PHOENIX, ARIZ.—F. H. Ensign, general manager of the Phoenix Gas & Electric Company in this city, has just returned from Los Angeles and states that he has let the final contract for electric machinery for the new station of the company in Phoenix. The equipment is to be furnished by the General Electric Company.

TRANSMISSION.

CORNING, CAL.—Notice of appropriation of 3,000 inches of water from South Digger Creek, has been filed by A. T. Forward, vice-president of the Sierra Electric Power Company. The water is to be used for generating electrical power.

HONOLULU, H. T.—The plans for the proposed power house in Nuuana Valley, which will furnish electricity for the lighting system of Honolulu, and which will also fill reservoirs with artesian water for domestic use, have been completed, and operations will begin immediately.

CHICO, CAL.—Thirty day options on large tracts of land in Big Meadows, Plumas County, California, have been taken by the Great Western Power Company, with the evident intention of erecting upon the land the second of its proposed string of power plants along the Feather River.

OAKLAND, CAL.—The new generating plant of the Pacific Gas & Electric Company in this city has been completed, having been entirely constructed in five months' time. The new plant has a 9,000 kilowatt capacity, generated by 12,000 horsepower steam turbines, and was constructed at a cost of $500,000.

CHICO, CAL.—The Sierra Electric Power Company, recently incorporated at Oakland, is to enter the field here in competition with the Pacific Gas & Electric Co., headquarters having been established in this city. The company proposes to erect its power plant on Digger Creek, Tehama County, California, fifty miles north of Chico. Water rights have been secured.

OAKLAND, CAL.—The California Electrical Generating Company has issued bonds to the amount of $5,000,000. This company has valuable holdings in the Sierra Nevada Mountains, and plan to bring electrical power to the cities bordering San Francisco Bay. It is declared by the company officials that a steam generating electrical power plant will be erected in Oakland in the immediate future. The corporation is capitalized at $7,500,000, entirely subscribed by the Board of Directors. Guy C. Earl is president, and W. H. Spaulding is secretary, the remaining directors being Charles W. Walter, Perry M. Reeves, Herold P. Pitts, Chester H. Pennover, Charles H. Benton, Charles E. Minard, Thomas B. Pheby, Jr., Thomas V. Maxwell, and Ernest W. D'Obrain.

SAN FRANCISCO, CAL.—The Tuolumne Water Supply Company, which has assumed control of the large land holdings of William Hammond Hall, in the Hetch Hetchy Valley, and which are essential to San Francisco's municipal water supply project, has incorporated here, with Jesse W. Lilienthal, Alexander M. More, and Henry H. Hart as directors. William Hammond Hall's lands comprise about 1,000 acres and were recently offered to San Francisco for $200,000, with the understanding that he retain the power rights. The Supervisors wished to take the power rights over also, but this proposition Hall refused. The new company has been organized for irrigation and power purposes, but Lilienthal asserts that the concern will deal fairly with the city.

OAKLAND, CAL.—Plans have been completed by the Great Western Power Company for the erection on the water front in this city, for a $1,000,000 electrical generating plant, [illegible] used as an auxiliary to the hydro-electric station of the company, and is a reinforcement in an emergency. Contracts [illegible] and other preliminary foundation work have [illegible] closed, and operations will begin within a few [illegible] expected that the plant will be in operation within [illegible] the work of construction is commenced. [illegible] modeled after that of the Chicago Edison [illegible] of steam turbine type, producing [illegible] 15,000 kilowatts and about 20,000 horse-[illegible] the first steam turbine plant of this mag-[illegible] California. The company expects to ultimately [illegible] at the plant.

PENDLETON, ORE.—The Peacock Milling Company has filed on 5,000 inches of water on the Walla Walla River, which will be used to generate electrical power.

SPOKANE, WASH.—Wm. A. Nicholls, president of the Big Bend Transit Company, announces that his company owns a power site on the Spokane River, capable of developing 25,000 horsepower, and will build at once an electric plant, starting with 10,000 horsepower.

WATERWORKS.

POMONA, CAL.—The Consolidated Water Company will expend more than $30,000 on its new high-pressure water system.

SAN JUAN, CAL.—The Board of Trustees of San Juan have ordered a proposed pipe line surveyed and advertised for bids.

LOS ANGELES, CAL.—The water department has awarded the contract for 5,000 meters to the Neptune Meter Company.

VENTURA, CAL.—The bid of P. Charlebois, amounting to $2,515, for 10,500 feet of 3-inch Standard black pipe, has been accepted by the Supervisors.

WAILUKU, H. T.—Data and surveys have been prepared for a proposed pipe line to carry water from the Kaalan mountains to the fields of Kula, and a report submitted.

LOS ANGELES, CAL.—Advertisements for bids in respect to a supply of steel piping in various sizes has been ordered by the City Council. The bids are to be opened on January 19th.

LOS ANGELES, CAL.—The Board of Public Works awarded the contract for the construction of the Antelope Valley division of the Owens River aqueduct to Perry A. Howard, at a cost of $529,008.

SACRAMENTO, CAL.—R. G. Hanford, a capitalist, is planning to offer Sacramento a supply of pure water, which he will probably divert from the American River and bring to Sacramento by means of pipe lines.

TURLOCK, CAL.—A special bond election to secure funds with which to construct sewers, sewer plant, lay pipes, construct a water plant, and lay mains will be held on January 18th. The proposed bonds call for a total of $53,000.

BERKELEY, CAL.—To secure water supply through the control of the drainage lands of Strawberry Creek, options on 700 acres of land have been secured by the University of California authorities. The land purchased will cost nearly $1,000,000.

ALAMEDA, CAL.—Louis Titus, president of the Peoples' Water Company, has assured the City Council that his company will keep his promises made several months ago to the effect that $7,000 worth of new pipes would be installed in the city.

SONORA, CAL.—Marsden Manson has transferred to San Francisco all his rights, titles, and interests to the filings of water rights of the Tuolumne River and Eleanor Creek in Tuolumne County. The filings were made under the official direction of Manson as the City Engineer of San Francisco.

GRIDLEY, CAL.—Sealed bids for furnishing the materials, erecting and constructing a waterworks and electric light building for Gridley will be received by the clerk of the Board of Trustees until January 11, 1909. Sealed bids for erecting and installing a pumping plant in the same city will be received until February 23rd.

LOS ANGELES, CAL.—In the third annual report of the accounting department of the Owens River Aqueduct, it is shown that the disbursements and cash on hand for the year ending November 30th, amounted to $3,201,049.97. The cash on hand November 30, 1907, amounted to $45,141.95, and the sum received from the sale of bonds was $3,092,776.61. The total Aqueduct construction account amounted to $3,542,860.92.

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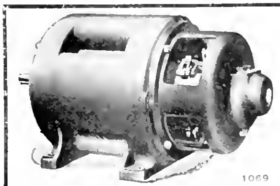

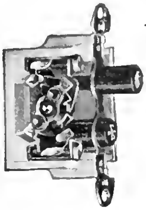

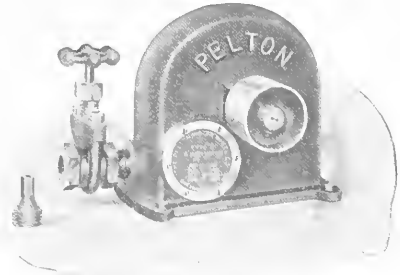

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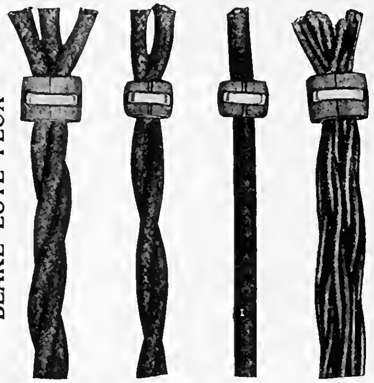

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VOLUME XXII. SAN FRANCISCO, JANUARY 16, 1909 NUMBER

DAM PROFILES.

By Lars Jorgensen

A concrete gravity dam as calculated in the preceding article is not necessarily the cheapest structure that can be put in to hold the water back and form a reservoir. This depends upon many other things, and first of all upon the nature of the ground upon which it is to be constructed and the locality; as this type requires a solid rock bottom to be economical and safe. Unfortunately, the engineer must be contented with whatever bottom he finds and build his structure to best suit the given case.

To meet the varying conditions to be met in practice there have been developed seven standard dam profiles, which, it is suposed, will cover nearly all cases.

Profile No. 1 is the concrete gravity dam shown in Figure 1b (Journal Electricity, Power and Gas, January 2nd, 1909.) It has a known factor of safety against overturning of not less than two at any depth.

The specfic gravity of the mass is taken at 2.13 (weight of one cubic foot, 145 lbs.). The spaces between the large stones in the cyclopean concrete being filled with a rather wet mixture in the proportion 1:3:6 for the up and down stream face, and in the proportion 1:3½:8 for the main body of the section. Half the bulk of this masonry is assumed to be concrete, the balance boulders and broken stone thrown in.

Small Regulating Reservoir at Head of Pressure Pipe, Crest of Earthen Dam to the Left.

In order to be better able to compare the merits of the

Cross section of Canyon

Fig. 1.

different profiles, we shall now figure the cost of dams, using all the profiles in succession and using the same dam site.

Figure 1 shows the contours of the site selected; the height of the dam is to be 115 feet. From this contour map and from the table given on drawing showing concrete gravity profile (Figure 1b—Journal Electricity, Power and Gas, January 2nd, 1909), the contents of the whole dam is found to be 47,200 yards. Of this 23,600 yards are concrete and the balance large stones. 15,300 out of the 23,600 yards are of a mixture 1:3½:8. Each yard of this mixture requires 0.82 barrel of cement, with stones 2½ inches and under. 15,300 x0.82=12,600 barrels. (In all following calculations a slide rule is used). The remaining (23,600—15,300)=8,300 yards are of a mixture 1:3:6, except 1,090 yards (the watertight facing) which are of a mixture 1:2:4. 8,300—1,090=7,210 yards requiring 1.02 barrels of cement per yard with stones 2½ inches and under. 7,210x1.02=7,360 barrels. Of the 1,090 yards of the mixture 1:2:4 each yard requiring 1.34 barrels of cement with stones ¾ inch and under. 1,090x1.34 =1,460 barrels.

Total cement for the complete dam 21,420 barrels. At this dam site the estimated cost of cement per barrel is $6.00. Therefore,

Cost of cement 6x21,420	$128,520.00
Sand required, 10,410 yards @ $1.00 per yard	10,410.00
Loose rock, 47,000 yards @ at $2.00 in place	94,000.00
Mixing 23,600 yards of concrete @ $1.00	23,600.00
Steel for water-tight facing	10,000.00
Total	$266,530.000

The above amount for standard profile No. 1.

Standard profile No. 2 has concrete facing up stream and down stream facing will, therefore, stand an overflow in

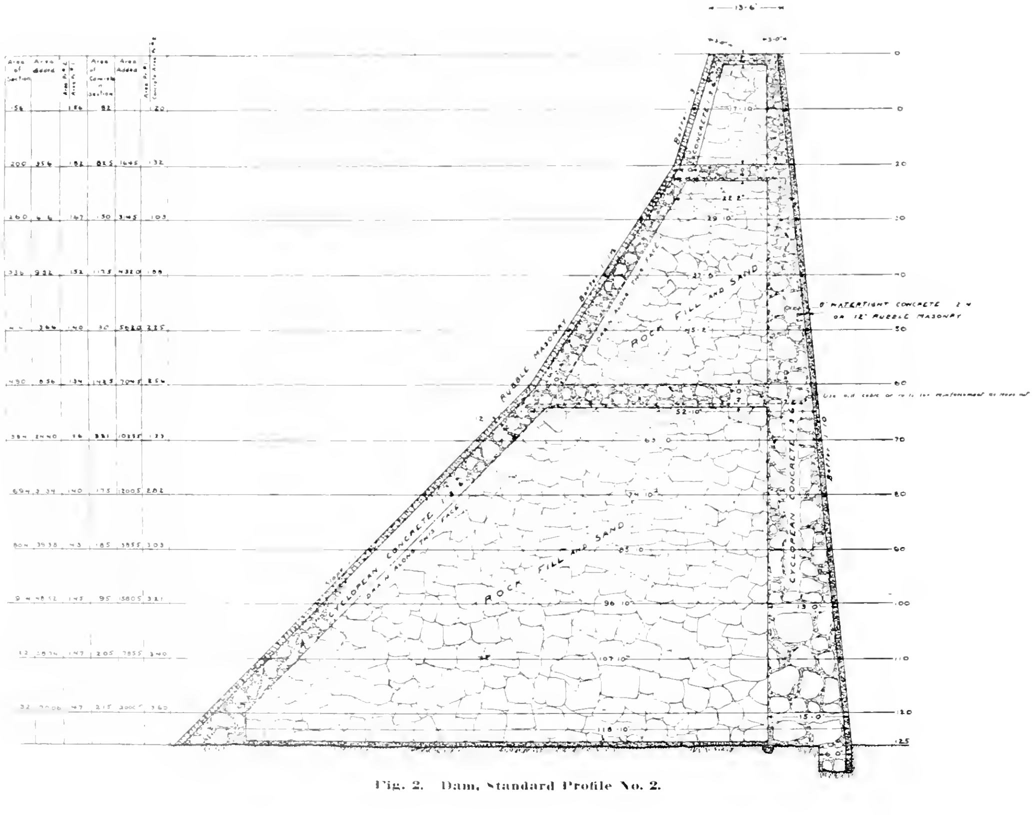


Fig. 2. Dam, Standard Profile No. 2.

emergency cases. The up and the down stream faces are tied together in two places through the body of the dam, thus tending to keep the whole section as one mass and cutting down the thickness of the up stream facing, which with reservoir empty, must act as a retaining wall. The central portion of the dam body is rock and sand dumped in, the sand filling the voids between the stones (voids taken 45% of the mass) making a tight dam and increasing the specific weight of the mass. This type of dam does not require a solid rock foundation on account of its wider base, but can be used where the ground is seamy and shattered. Only the up stream facing need be carried to solid rock.

Standard profile No. 3 has rubble masonry up and down stream facing and rockfill and sand main body. The up stream facing must be strong enough to stand as a retaining wall with reservoir empty. In constructing this type of dam forms are done away with altogether. 82,000 yards of material is required for a 115-foot dam, of this 27,700 yards are rubble masonry; the balance (54,300 yards) rockfill and sand. Of the 27,700 yards rubble masonry, half is laid in mortar $\frac{27700}{2}=13850$.

The mortar required is estimated at 25% of the mass, or $\frac{13850}{4}=3{,}462$ yards., and consists of 1 part of cement to three parts of mixed sand and small gravel. Each yard of

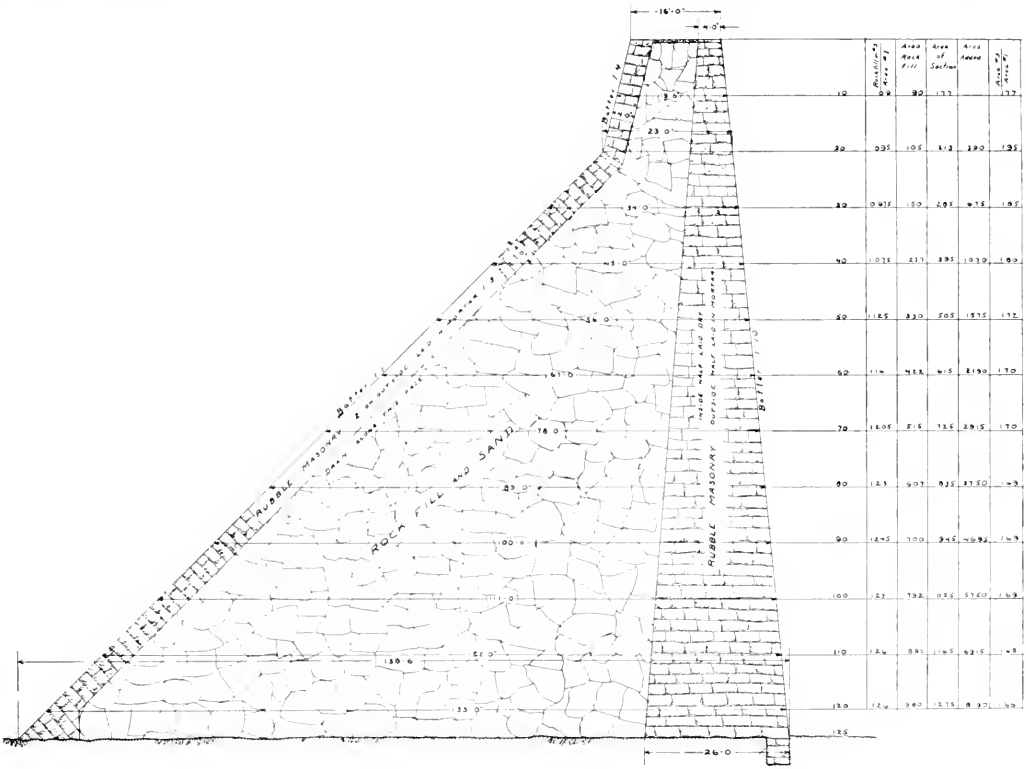


Fig. 3. Dam, Standard Profile No. 3.

The stresses in this and all following profiles cannot be calculated. Arching dams with this or any of the following profiles does not add to their strength. The factor of safety although unknown is supposed to be more than 2 at any depth. The weight of one cubic foot of cyclopean concrete is taken at 145 pounds. This is a low value at this particular dam site and will allow about 10 pounds for floatation. The weight of the fill is taken at 130 pounds per cubic foot.

In the table given in Figure 2 areas of the profile between 10' intervals are given and also the proportion between the corresponding areas of standard profile No. 1 and No. 2. This makes possible quick comparison of the different profiles.

Using profile No. 2 the total yards of material in a 115 foot dam on the site shown in Figure 1 is 69,200.

Cement required, 13,190 bbls. @ $6.00 at dam site	$ 79,140
Sand, 26,050 yards @ $1.00	26,050
Loose rock, 69,000 yards @ $2.00	138,000
Mixing, 24,100 yards @ $1.00	24,100
Steel for water tight facing	10,000
	$277,290

this mixture requires 2.30 barrels of cement. Total 3,462x 2.3=7,970 barrels.

Cement required for Profile No. 3, 7,970 bbls. @ $6.00	$ 47,820
Sand, 28,170 yards @ $1.00	28,170
Rock, 82,000 yards @ $2.00	164,000
Mixing, 3,462 yards @ $1.00	3,462
Laying 27,700 yards of rubble masonry @ $2.00	55,400
	$298,852

Profiles No. 4 and No. 5 are nearly alike, the main difference being in the batter of the up stream face. No. 4 requires more material but less labor than No. 5. The ground upon which they may be built does not need to be even as solid as that required for No. 2 and No. 3, on account of their still wider base.

The tables accompanying the drawings are useful for making quick determinations of the contents of dams on a given site. The estimated cost of a dam with profile No. 4 on the site shown in Figure 1 is $431,500, and that of a dam with profile No. 5 $326,600.

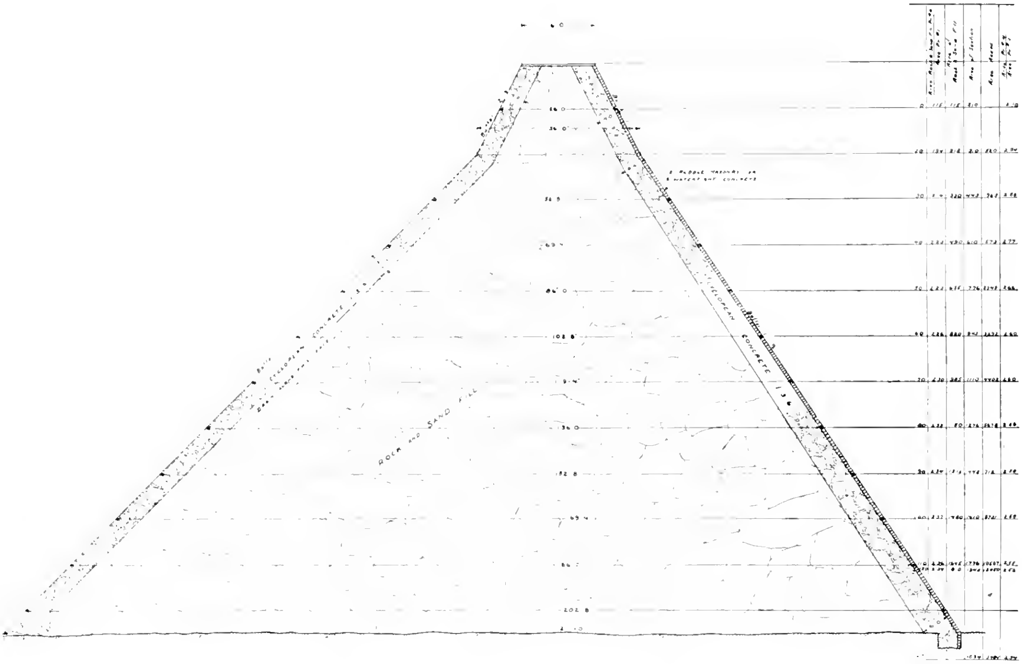


Fig. 4. Dam, Standard Profile No. 4.

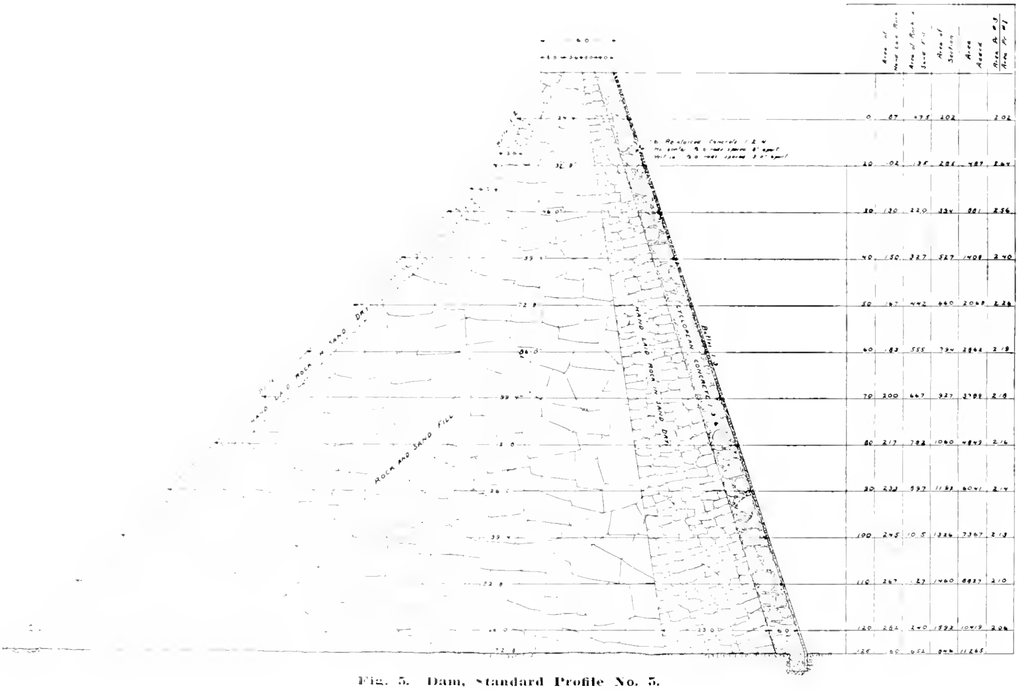


Fig. 5. Dam, Standard Profile No. 5.

The difference in cost of dams using profile Nos. 1, 2 and 3 on the site in question is very slight, especially if the cost of preparing the foundation is added, as this will be the highest for No. 1 and less for Nos. 2 and 3.

Profiles No. 4 and No. 5 are not favorable in cost for this particular locality. They would show up to better advantage in places far from the railroad, where cement would cost, say $10 per barrel at the site, and where loose rock was plentiful near the site.

Profiles No. 6a and No. 6b cannot be used for comparison in this case, as there is not earth or sand enough near the dam sites with which to build these types. In type 6a the water-tight core is placed near the up stream face; the middle portion consists of earth or sand sluiced into place and the down stream face is provided with a rock rip rap to keep it from washing out. Dams of this type can be built to best advantage where earth is plentiful and rock scarce. Type 6b requires both loose rock and sand or earth in large quantities; the water-tight core is placed in the middle of the profile with rock-fill and earth on both sides.

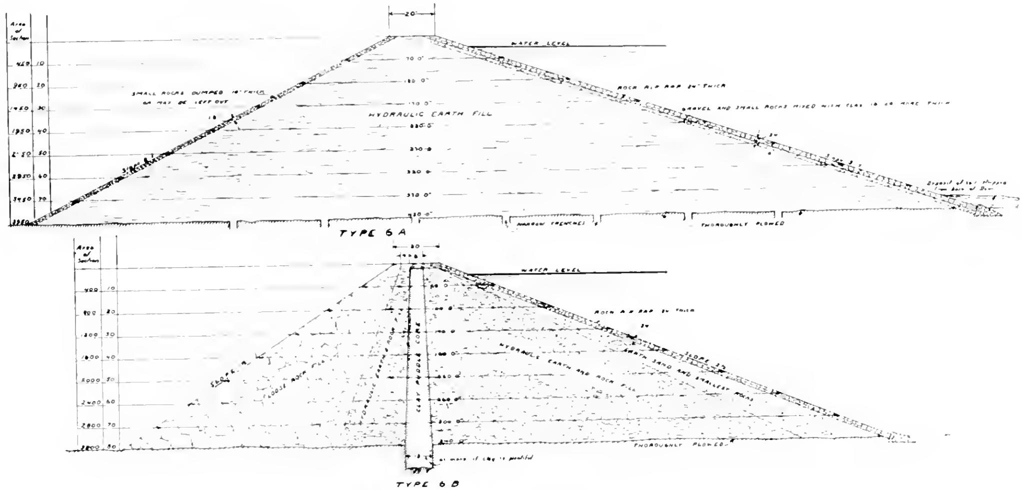


Fig. 6. Dam, Standard Profile No. 6.

Had the cross section of the canyon been of a different shape, the relative cost of the several profiles would have been different, even with the same unit prices of material, showing that each case must be figured separate. For dams much over 120 feet high, the reinforced water-tight facing cannot accomplish what it is intended for any more, the percolation of water through the 8" sheet of concrete would be too great on account of the high pressure. We would either have to reinforce the dam itself, as shown in Figure 5 (Journal of Electricity, Power and Gas, January 2, 1909), or allow more for flotation when calculating the weight of material necessary to resist the horizontal component of the water pressure.

Electric power from a windmill is being successfully generated at Askov, Denmark. Two direct-current, 12-horsepower motors are driven by windmill having four wings, each 8 feet wide and 25 feet long. The current averages 21 amperes, and through the medium of a storage battery supplies energy for light and power. The current is automatically cut out when the tension becomes less than that of the storage battery. Forty other plants have been installed by a Danish company organized for this purpose.

[1]PRESSURE FLUCTUATIONS IN TURBINE PIPE LINES.

By Prof. A. Budau, Engineer, Vienna, Austria.

(Concluded.)

Upon the question where the potential energy of the flowing water goes, one can reply that part of same reaches with the water with increased pressure the tailwater through the nozzle. The part transformed into pressure, viz., the resulting rise in pressure, does not remain passive. The pipes dilated by same gradually contract again and force the surplus of contents upwards, whereby on account of the kinetic energy of the water flowing opposite to the water entering the pipe, after some time a drop of pressure takes place at the lower end of the pipe; hereupon follows again a downflow and a somewhat smaller rise of pressure. And so the water in the pipe line oscillates for considerable time (frequently half an hour) up and down, until the pipe friction and the friction of the particles of water between themselves have destroyed the remaining amount of energy. Therefore, by sudden closure, an impulse for vibrations of the water in the pipe line is always given.

If the line is closed by the turbine governor not entirely but partially, a smaller rise of pressure takes place. In this case, however, the governor remains in action and helps considerably not to let the aforesaid vibrations come to rest, since it always closes when a pressure rise takes place, thereby still more raising the pressure, and always opens when the pressure falls in the line, whereupon the drop in pressure continues, etc. The vibrations of the water increase to a maximum and then remain constant. It may be mentioned that sometimes the entire pipe line takes part in these vibrations and even leaves its supports at points of change in direction; the writer had occasion to observe such occurrences.

An analytical treatment of these occurrences would be of theoretical interest only and hardly furnish results applicable in practice; in those cases, namely, where vibrations in the pipe line are, in fact, caused by the governor, one is compelled to put the governor out of service unless one succeeds in stopping this condition by opening a by-pass or by other means, viz., changing the closing time, raising the degrees of unsteadiness.

[1] Translated from the German and partly read by Heinrich Homberger, before the Technical Society of the Pacific Coast. Reprinted from Journal of the Association of Engineering Societies.

The relation of these factors, to which secondary points are connected, that are beyond any calculation, is so complicated that it is impossible to expect the engineer, who has to start up the governor, to calculate and check up these vibrations.

The possibility of an occurrence of high pressures, however, under the conditions of service just mentioned, makes it seem advisable to dimension the pipe line in such cases sufficiently liberally to withstand even at sudden closure the rise of pressure occurring with a factor of safety of 2½.

STANDPIPES, FREE-AIR PIPES.

The arrangement of standpipes can be such that the upper, sometimes flaring, edge is level with the water surface in the reservoir, so that, at a slight pressure rise, overflowing of the water over the upper edge of the pipe takes place. Or the standpipe can be higher, so that the overflow only takes place at a considerable increase in pressure. Both arrangements have been installed, the latter especially, where it was difficult to carry away the overflowing water.

One would think that standpipes, especially if installed at the lower end of the pipe line, would be capable of affording absolute safety against bursting of pipes. This, however, is not so, since at sudden closure part of the energy of the water flowing in the pipe line has to be used to accelerate the water in the standpipe. A resting body of water of such considerable volume requires for its setting in motion a fair amount of energy, and can in no case be suddenly brought from rest to a certain velocity. Therefrom

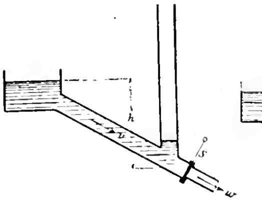


Fig. 11.

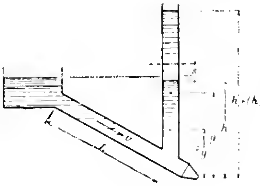


Fig. 12.

results that also with standpipes considerable rise of pressure will occur at the lower end of pipe lines, and it only depends upon the ratio between the length of the pipe line and the height of the standpipe and upon the ratio between the thickness and the diameter of the pipe whether at all a standpipe affords an effective protection to the pipe line.

The pressure rises occurring with standpipes at the lower end of pipe lines at sudden closure of the line will now be investigated and calculated. A standpipe of the second type mentioned shall be assumed, whose height is such that an overflow over the upper edge of the pipe cannot take place even with the greatest occurring pressure rise.

Frst the simple case will be treated, where the velocity of flow in the pipe line is so great that the flow and discharge take place with a velocity due to the entire head, so that, if the water flows through the line with the velocity $v = \sqrt{2gh}$, the level of the water in the standpipe is very low, as shown in Fig. 11, and the amount of water contained therein can be neglected.

At sudden closure of the pipe line—for instance by the gate S—the water will first rise to the level h on account of the hydrostatic pressure; then, however, on account of the energy of the water stopped in its flow, beyond this, up to $h + (h)$. (Fig. 12.)

Suppose that for this additional rise (h), the entire kinetic energy acts, viz., the amount $A = \frac{FL\gamma}{g} \frac{v^2}{2}$, the volume of lifted water $F(h)\gamma$ multiplied with the path of the center of gravity S, viz., $\frac{(h)}{2}$, will represent the work performed and it can be made $\frac{FL\gamma}{g} \frac{v^2}{2} = F(h)\gamma \frac{(h)}{2}$, which is expressed more simply, considering that $v = \sqrt{2gh}$,

$$Lh = \frac{(h)^2}{2};$$

or,

$$(H) = \sqrt{2Lh}. \qquad \text{XVII}$$

The maximum pressure occurring will, therefore, be

$$h + (h) = h \times \sqrt{2Lh} = h + v\sqrt{\frac{L}{g}}.$$

The increase in pressure is, as has to be expected, the greater the longer the pipe line is and the more rapidly the water flows therein; therefore, it also depends upon the head h, proportional to its root, however.

With turbine pipe lines the area of discharge from the nozzle is always considerably smaller than the area of the pipe line; therefore, the velocity of flow v in the pipe line is considerably smaller than $\sqrt{2gh}$.

If the area of discharge is designated by f and the velocity of discharge by w, on account of the law of continuity, $vF = fw$, therefrom with given areas and known velocity of the discharge of the water from the turbine gate, the velocity v of the water in the pipe line can always be easily found.

If the turbine gate is closed suddenly, an impact of the moving body of water of the mass $\frac{LF\gamma}{g} = M^1$ against the mass of water stationary in the standpipe $M^{II} = \frac{hF\gamma}{g}$ takes place and the latter will be set in an upward motion up to a certain height (h) which will be reached after T seconds. In this case, also considering the dilation of the pipe, which takes place during a short period after the impact and then disappears again, the energy of the flowing water is used exclusively to lift the entire column of water in the standpipe.

If y (Fig. 12) indicates the height of the center of gravity of the water column above the opening of discharge, and y' the position of the center of gravity after the water column reached its highest position, therefore $y' - y$ the rise of the center of gravity, then $y' \frac{h + (h)}{g} F\gamma - y \frac{h}{g} F\gamma$ is the work performed, which, on the other hand, must equal the kinetic energy of the water, so that one can say:

$$y' \frac{F\gamma}{g} [h + (h)] - y \frac{h}{g} F\gamma = \frac{LF\gamma}{g} \frac{v^2}{2};$$

and since

$$y = \frac{h}{2} \text{ and } y' = \frac{h + (h)}{2},$$

it follows that

$$\tfrac{1}{2} [h + (h)]^2 - \frac{h^2}{2} = L\frac{v^2}{2};$$

or

$$2(h)h - (h)^2 = Lv^2.$$

From this equation (h) can be calculated. The calculated value, however, will always be greater than the actually occurring rise in pressure (h), since part of the kinetic energy is used up in forming eddies and transformed into heat.

Solved the squared equation, XVIII gives

$$(h) = \sqrt{h^2 + Lv} - h.$$

Approximately also the time can be calculated after which this rise in pressure will be reached.

If the moving mass of water M^1 strikes the stationary mass of water M^{II}, a deformation of the pipes must occur (since the water is assumed to be incompressible) which

takes up the energy $\frac{M' v^2}{2}$ while this dilatation takes place the motion of the mass M'' already commences, and when the dilatation after a very short period of time reaches its maximum value, the two masses of water move with the joint velocity v_1 which can be calculated as impact of unelastic bodies from the formula $v_1 = \frac{M' v}{M' + M''}$. This is the velocity the water in the pipe line and in the standpipe has after the impact. Now, however, the column of water in the standpipe rises; this causes a counterforce which retards the motion. At the same time the pipes gradually contract again and transfer the previously received energy again to the water. Finally, when the motion of the water reaches its end the previously calculated maximum value of the rise (h) will be reached.

For the motion to be considered here the differential equation, well known from dynamics, stands $\frac{d^2s}{dt^2} = -q$, where q represents the retardation of the water flowing in the pipe line. The counteracting force is the weight of the body of water rising above the original level in the standpipe. This counterforce is directly proportional to the rise; therefore can be expressed by $K = \text{Const.} \cdot s$. For $s = (h)$, $K = F(h)\gamma$; therefore Const. $= F$ and $K = F\gamma s$.

The acceleration is given by the ratio of force to mass; therefore

$$q = \frac{F\gamma s}{M' + M''} = \frac{F\gamma s}{\frac{F\gamma L}{g} + \frac{F\gamma h}{g}} = \frac{sg}{L + H}.$$

Accordingly, the above differential equation becomes

$$\frac{d^2s}{dt^2} + \frac{sg}{L + h} = 0.$$

The latter equation is the one of the sinoidal curve. Making $\sqrt{\frac{g}{L+h}} = a$, the general integral is

$$s = A \cos a\,t + B \sin a\,t,$$

wherein $A = (h) \sin\beta$ and $B = (h) \cos\beta$, and β represents the phase of the vibration.

Since in the considered case the phase change disappears, since time is counted from the passing of the center position, $\beta = 0$, $A = 0$ and $B = (h)$, therefore

$$s = (h) \sin \sqrt{\frac{g}{L+H}} \cdot t;$$

for $s = (h)$, $t = T$; thus

$$(H) = \sqrt{\frac{g}{L+H}}\; T,$$

and

$$\sqrt{\frac{g}{L+H}} \cdot T = \text{arc sin } 1 = \frac{\pi}{2}$$

or, finally,

$$T = \frac{\pi}{2}\sqrt{\frac{L+H}{g}}.$$

This shows that the maximum value of the calculable pressure rise at the end of the line will occur the later, the longer the line and the higher the standpipe. But it may be mentioned again, that, on account of the compressibility of the water and of the consequent velocity of travel of the pressure in the water, considerable deviations from the above results of calculation have to be expected, especially if the line is very long.

After having reached the highest position the water in the standpipe will drop again, and the entire mass of water will adopt a velocity opposite to the one previously had, which reaches its maximum at the moment the original level h is reached, but afterwards decreases again. Hereby the water is forced back into the reservoir, the level of water in the standpipe sinks to the amount s below the level h. Now again begins the flow of the water in the original direction, rise beyond the level h, and so forth.

Sinoidal vibrations of the water take place, which, on account of several damping factors, amongst which the friction of the water against the pipe walls, gradually come to rest.

If the standpipe is of such shape that the water can overflow when it rises, the time T, after which the maximum pressure rise occurs, and the amount of the latter, change only inconsiderably, both becoming smaller. The only considerable influence the overflowing of the water has is upon the back vibration of the water, which is practically of no importance, since the mass of water has been reduced on account of the overflow. The back vibrations, therefore, become smaller, but the strain of the pipes at the lower end of the line will be the same when the gate is closed as if no overflow of the water takes place.

Air Chambers.

From the preceding discussions of standpipes the action of air chambers may be immediately considered.

They act principally upon the pressure conditions of a pipe line like standpipes with which an overflow of the water does not take place and which are so short that the mass of the water contained therein, M'', need not be considered. The analytical investigation of the pressure conditions at sudden and rapid closure can be simplified by introducing the volume of the air chamber as a cylinder of the area of the pipe line and a height L_1, which can be brought into a simple relation to the length of the pipe line.

For the changes in pressure and volume of the air, the Mariotte Law can be applied with quite sufficient approximation.

After a rapid or sudden closure the energy of the flowing water will principally compress the air contained in the air chamber. If the maximum pressure in the air chamber is reached, which always will take place a considerable time after closing the gate, the air expands again and forces the water contained in the air chamber back into the pipe line; then follows again a pressure rise and so forth, since here the impulses of vibration are nearly the same as with standpipes. But as the mass of water is smaller than with a standpipe, the vibrations will take place at shorter intervals; the maximum value of the pressure rise will be the same as with standpipes.

Air chambers are no more used to-day, so that a further investigation of the occurrences connected therewith can be dispensed with.

By-Passes (Synchronous Gates.)

A clear illustration of a synchronous gate is given in Fig. 13, which shows an impulse wheel built by the firm of Messrs. Riva, Monneret & Co., of Milan, for the electric station of the power transmission plant Villadossola-Intra.

The impulse wheel A, cast of steel, takes water from a single nozzle B, whose area of discharge can be reduced by means of a tongue with bell-crank. The bell-crank is connected by a link with a piston C, which is always pressed upward, if the space above the piston communicates with the atmosphere. If, however, pressure water enters this space, the water pressure acting upon the tongue opens the water inlet. The admission of the pressure water takes place through the balanced piston valve D, which is operated by a Hartung governor. In customary manner over-regulation is avoided by the floating lever E, moving back the valve D. From the piston rod a horizontal lever G branches off, which, by means of a link, operates the synchronous gate H, and this in such a way that with the tongue closed the entire maximum area of the nozzle is open in the synchronous gate. With the nozzle entirely open, however, the gate H is fully closed. Therefore, to the water in the pipe line the same discharge

area is offered all the time, and a pressure rise or drop cannot take place in the pipe line with a change of nozzle opening. The discharge from the gate into the tailrace must be directed through a dampening apparatus, which, as much as possible, destroys the energy of the discharge water; otherwise the issuing jet of water could easily destroy the masonry of the tailrace.

Synchronous gates of such arrangement, however, have the disadvantage that a maximum quantity of water is always used, not considering whether the turbine runs under full load or almost at no load. A storage of the water in the intake is impossible with this arrangement. Therefore, where storage basins are provided, and at times water has to be saved as much as possible, such synchronous gates cannot be applied, or have to be shut down when water is short.

In those cases, where the available quantity of water is sometimes less than the turbine can consume at full opening, the valve of the synchronous gate must be made adjustable, so that with the nozzle of the turbine fully closed it only opens in accordance with the available quantity of water. This arrangement offers no constructive difficulties, but no fargoing economy of water can be obtained with it. In Fig. 13, the handwheel K is for this adjustment.

There are, however, also devices where the synchronous gate opens quickly at rapid closure of the nozzle, thus avoiding any pressure rise in the line, but then closes slowly, so

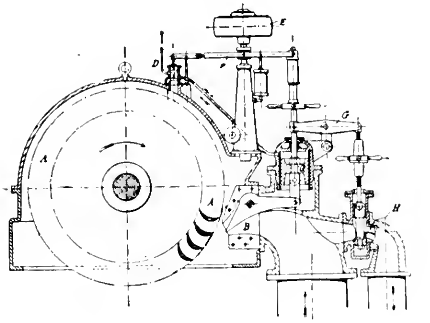


Fig. 13.

that the discharge of water through the by-pass takes place only during a short adjustable period. Of the many possible designs solving this problem, the two illustrated in Figs 14 and 15 my be mentioned.

In Fig. 14, the lever H is connected with the governor shaft A in such a way that with the closing motion of the shaft the left end of the lever rises. Hereby an oil cataract is lifted, since the oil above the piston K of the cataract cannot quickly enough flow down through a small opening O in the piston. In the bottom of the cataract a valve pin V is inserted, which closes an opening M in the upper cover of the discharging casing, through which water flows from the chamber N through the pipe R into the tailrace. If this opening is uncovered by lifting the cataract, the pressure drops in the chamber N above the valve piston, and the latter, lifted by the pressure of the water upon the valve W, moves upward, hereby lifting the valve W, so that through the same, water can flow from the pipe line B through the curved pipe D into the tailrace.

When the lever H stops, the cataract slowly sinks. The velocity of this downward motion can be regulated at will by changing the opening in the cataract piston or by dropping weights into the cup-shaped extension P of the cataract, and finally the valve pin V again closes the opening M. Through a bore in the valve plunger, water enters the chamber N, whereupon soon the pressure in the pipe line is established in N and the valve W is forced downward and finally closed, since the diameter of the plunger is larger than that of the valve. At the downward motion of the lever H, the small valve F in the cataract piston comes into action, which permits the cataract fluid to flow quickly from below the piston above the same.

Less clever but simpler and, therefore less subjected to various disturbing incidents, is the device shown in Fig. 15. As in Fig. 14, from the pipe line B a fitting branches off which terminates in a piston valve chest. The governor shaft A acts by means of the lever H upon the piston K of an oil cataract, which is rigidly fastened to the other end of the piston rod V of the piston valve S. The piston K has one or several holes O, and a valve F, which permit an easy drop of the piston when the piston valve is completely closed. The action of this device is analogous to the one described in Fig. 14, and, therefore, requires no further explanation. Weights P insure the drop of the piston into the closed position, which takes place quicker the more weights are added. The piston of the oil cataract must be at least of such area as corresponds with the resistance against its upward motion plus the loaded cataract casing under the most unfavorable circumstances.

One would think that by installing such quick-opening and slow-closing devices the desired result was reached, viz., the pipe line protected against excessive strains, best pos-

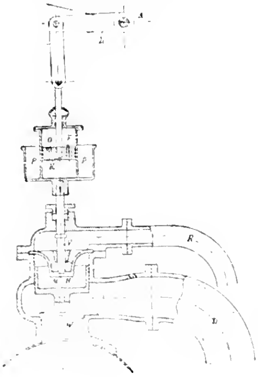


Fig. 14.

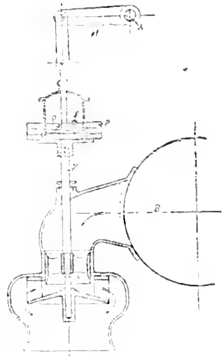


Fig. 15.

sible economy of water guaranteed and the action of the governor improved by maintaining as much as possible constant pressure in the pipe line. In all three directions mentioned, however, cataract devices are imperfect in their performance.

So far only the pressure rise at rapid closing of a pipe line has been taken into consideration. But with rapid opening of the supply pipe a considerable drop of pressure occurs in the pipe line, which unfavorably influences the action of the governor. The entire mass of water in the pipe line has, with an increased load on the turbine, to be accelerated from a velocity v_1 to a higher velocity v_2 and this cannot occur suddenly, but a certain time is required. However perfect the turbine governor might be, by opening the supply apparatus instantly at a drop of speed in the first moment no greater quantity of water will pass through the turbine and only gradually the water will be accelerated to the required velocity. In the meantime, however, the governor has opened the supply apparatus much further than necessary and must close again, viz., it has worked too far. At the following closure the by-pass will be opened and a quantity of the valuable water flows needlessly into the tailrace, for there is no danger for the pipe line. Standpipes near the power house can be of favorable influence, since they supply ample water to the turbine in case of a sudden drop in pressure.

In plants where the load of the turbine is changing frequently and considerably, the loss of water at both clos-

ing and opening can become so great that it many nearly reach the one caused by a simple synchronous gate. Also with the closing of the turbine the cataract apparatus can become wasteful if it is not properly adjusted or if the originally correct adjustment has changed on account of various influences, viz., thickening of the oil, corrosion of the sliding surfaces, foreign bodies between the sliding surfaces. Then one cannot expect any more that with a certain rise of the lever H, corsesponding with a certain closure of the supply apparatus, the valve in Fig. 14 or the piston in Fig. 15 is lifted just so high as to give to the water an area to enter the tailrace equal to the reduction of area in the supply apparatus. Rise and drop of pressure in the pipe line, which makes the governor oscillate, are then unavoidable. If then the apparatus remains in the open position, which can happen with the devices as Figs. 14 and 15 on account of sticking, if they are not sufficiently loaded, a considerable amount of water flows needlessly into the tailrace. If then the turbine gets a full load it can happen that not enough water remains to run it, that it slows down more and more and has to be shut down for cleaning the by-pass apparatus.

Inelectric plants, where frequently a fine is imposed upon interruptions of service, such would be most disagreeable. It is therefore, advisable to always insert a gate between the pipe line and the cataract apparatus so that the latter may be cleaned without interruption of service. If, however, such a gate is provided it will mostly happen that the attendants keep it closed all the time, thus feeling safer against disturbances. Especially in winter time, when the formation of ice may obstruct the apparatus in a manner hard to control, it is sometimes unavoidable to shut it down entirely. If then the service is satisfactory without it one cannot blame the attendants if they put it in commission only if visitors come to the hydro-electric power plant.

Conclusions.

From the preceding investigations it follows that under ordinary circumstances, viz., if the maximum velocity of the water in the turbine pipe line does not exceed 6 feet, if the pipe line is not very long, if the pipes are made of sheet iron and if the ratio between the thickness of the material and the diameter does not go beyond a certain point, a danger of rupture does not exist at the quickest possible closures.

If, under a high head and the resulting unfavorable relation between thickness of material and diameter of pipe, danger of rupture exists—this can be determined by formula XI—it has first to be considered whether by reducing the velocity of flow, eventually subdividing the pipe lines, this danger could not be avoided. Then any safety device can be dispensed with, the more so as they not always give a definite guarantee against rupture of pipes and only make the operation of the power plant more complicated. In such cases, where below the power plant the water has to be delivered continuously, by-passes similar to the one shown in Fig. 13 cannot be avoided. If, however, the pipe line is very long and with closure within 2 seconds, a danger of rupture still exists, groups of spring balanced safety valves, applied at the lower end of the pipe line, are the simplest and best safety-device.

If in case of rapid loading or unloading of the turbine the governor gets to oscillating badly, on account of considerable pressure rise or drop in the pipe line, the opening of a by-pass, which has to be provided anyhow as a drain, offers a simple means for damping the oscillations. By suitable rules of operation the increases and decreases occurring in the load of the turbine can be made gradual, which considerably lightens the task of the governor. From experiences of the writer the operation of quick-acting governors with high heads and long pipe lines is still feasible without any device to keep the pressure in the pipe constant, if the ratio of the energy A of the water flowing in the line to the maximum output of the turbine does not exceed the value $B_r = \frac{A}{HP} = 30$, and the fly-wheel masses are so ample that the ratio of the energy of the fly-wheel masses, $\frac{JW^2}{2}$, to the maximum output does not drop below the value $B_m = \frac{JW^2}{2HP} = 300$. Herewith an entirely perfect governor is assumed, whose closing time is 3 seconds as a maximum, with a degree of unsteadiness of the governor of 6 per cent. total. As long as the ratio of the energy of the water in the pipe to the energy of the fly-wheel masses, the characteristic figure $B = \frac{B_r}{B_m} = \frac{1}{10}$ is not exceeded, one can expect the governor to operate without periodic oscillations even without by-pass. This ratio also shows that if B is more than $\frac{1}{10}$ one is not yet compelled to institute by-passes, but can obtain satisfactory working of the governor by increasing the fly-wheel masses.

If the turbine takes little water only the governor wants to be aided occasionally by opening a by-pass, since, as mentioned, the inclination to oscillations of the line (breathing of the pipe line) is the smaller the faster the water flows through same. It always has to be borne in mind that the problem of regulating high-pressure turbines is a problem of vibrations, and an insight into the occurring phenomena is extremely difficult to obtain. The practicing engineer, whose endeavor is always to disclose the occurring phenomena and to reveal their causes, will very likely prefer to avoid all such devices, which, like cataract apparatus, will add to the already complicated conditions some factors which are entirely beyond calculation.

The telegraph question between China and Japan on account of the peculiar conditions in relation to telegraph lines near the Asiatic coast line, following the Russo-Japanese war, has been settled so that the submarine telegraph cable between Kwantung Province and Chefoo shall be divided between the two countries, the section from Kwantung Province to a point 7½ miles from the shore at Chefoo being held by Japan, and the section beyond that point by China. China shall construct a telegraph line from the landing point of the submarine cable to the Japanese postoffice at Chefoo, and that the Japanese postoffice at Chefoo shall deal with messages in Japanese kana characters for the convenience of Japanese. Those telegraph lines constructed by Japan in Manchuria during the Russo-Japanese war remaining outside the railway boundary shall be purchased by China; but even after the purchase of such lines a Japanese staff shall, for the convenience of Japanese residents in the open cities in Manchuria, be authorized to deal in Manchuria with messages in Japanese under a special arrangement. Minor regulations are to be arranged later on the same basis.

BAKERSFIELD, CAL.—J. I. Wagy has filed suit against I. E. Smith, J. E. Lynch and J. W. Mosher of Stockton, Cal., who own and control the Maricopa Road Oil and Gate City Oil Companies. Wagy owns a fourth interest in the first named concern and alleges that by a false directors' meeting, held in this city in September, the 300,000 shares, one-half of the total amount, of Maricopa Road Oil stock owned by three other parties were turned over to Lynch, Smith and Mosher and since that time the Stockton men have mismanaged the affairs and misappropriated the funds of the concern. He also alleges that they have threatened to force him from the company. He asks for a permanent injunction restraining the three men from the management and control of the company.

TRANSFORMER TESTING.[1]

The static transformer in mechanical make-up, while one of the simplest of electrical devices, is theoretically very complicated. In nearly all publications issued for the benefit of central station operators, relative to transformers, the matter is presented in a too complicated form to be of practical use and appreciated by the practical central station operator. The object here is to present, in a simple manner, methods of testing which will assist central station engineers in testing out transformers of any make, so that they can determine the relative value and performance of same.

These methods of test are classified under three heads:

1st. Test to determine condition.
2d. Test to determine performance.
3d. Test to determine capacity.

Tests to determine conditions are:

Insulation breakdown tests from primary to secondary.
Insulation breakdown tests from primary to iron.
Insulation breakdown tests from secondary to iron.
Double or triple potential test on the winding.

Tests to determine performance of transformers are:

Measurement of core loss and exciting current.
Measurement of impedance volts and watts.
Ratio of transformation.
Polarity.
Regulation.

Test to determine capacity of transformer is:

Heat run.

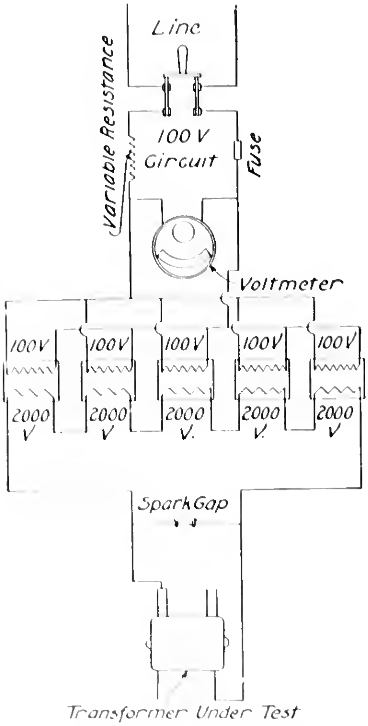


Fig. 1—Connections for Insulation Test Standard Transformer Method.

[1] From "A Practical Guide for Transformer Testing," issued by Fort Wayne Electric Works.

Insulation Test.

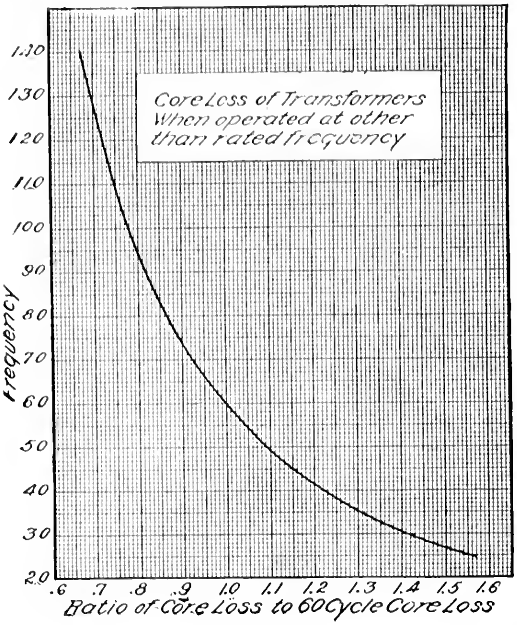
All makes of standard transformers, that is, transformers designed to operate on circuits of approximately 1100 or 2200 volts primary, and 110, 220 or 440 volts secondary, should withstand for a period of five minutes, a difference of potential of 10,000 volts (alternating current) between primary and secondary, and 10,000 volts between primary and core, and 5,000 volts between secondary and core, and should also withstand a "no load run" at triple potential or voltage for one-half hour, either on primary or secondary winding. (A. I. E. E.)

The triple potential test should be made on a circuit of 125 cycles or more, as this test made on low frequency circuits is harmful to the transformer due to the heavy exciting current.

It is desirable when making the insulation test between primary and secondary and between primary and core, to have all leads of each winding together, and also to ground the secondary winding to the core.

In making the above tests it is advisable to have a special transformer wound for 10,000 volts, but where this is not to be had, the test can be made by using five transformers each of approximately 2,000 volts primary, as shown in Fig. 1. Care should be taken to bring the voltage up gradually on the 100-volt side of the transformers, as there is a potential difference on the end transformer of 10,000 volts between the primary and secondary winding. This method is not advisable and should be used only when the testing transformer cannot be obtained.

The spark gap as shown in Fig. 1 should be adjusted according to curve I.



Curve III.

After the adjustment is made and the sparking distance is attained between the new needle points, which must be used at every discharge, the power can be shut off and the spark gap increased 10%, above the distance given in curve, after which the voltage should be brought up to former adjustment, as shown by voltmeter, Fig. 1. The spark gap, therefore, will not discharge unless the desired voltage has been exceeded by 10%, and in that case will serve to protect the transformer from excessive strain.

Losses.

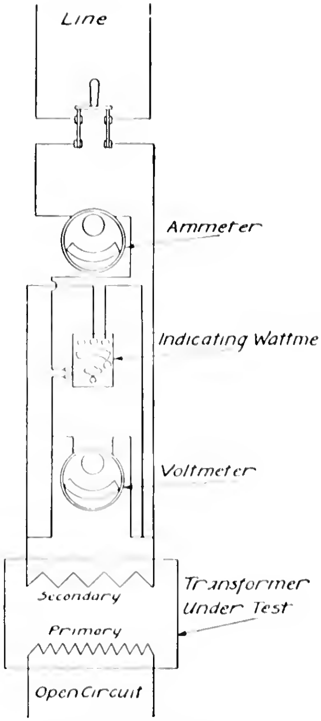


Fig. 2—Connections for Core Loss Test First Method.

The losses which take place in a transformer are the core loss and copper loss.

The core loss consists of the hysteretic loss due to cyclic reversals of the particles of iron composing the core, and the eddy current loss due to short circuited currents generated in the core.

Testing for Core Loss and Exciting Current.

The core loss is taken at voltage of proper frequency impressed across the low voltage terminals of the transformer under test. Fig. 2 shows diagram of connections for this test.

The wattmeter indicates the core loss, and the ammeter the exciting current.

If no indicating wattmeter is available for this test a recording wattmeter may be used by connecting as shown in Fig. 3. This wattmeter should be of the same voltage as transformer under test and of sufficient capacity to carry current as indicated by ammeter, Fig. 3. A five-ampere meter will usually be the best suited for transformers up to and including 50 K. W. capacity.

The core loss of a 5 K. W. transformer, which we know to be 48 watts, may be checked as follows:

Connect the meter as shown in Fig. 3, care being taken to install the meter as recommended in instruction book which accompanies the meter. With 110 volts, 60 cycles, sine wave impressed across the secondary terminals, the meter cup will make 5 revolutions in 93.5 seconds.

The following formula may be used to obtain watts:

$$\frac{\text{Revolutions of cup} \times 3600 \times \text{Constant marked on meter cup (in this case .25)}}{\text{Seconds required to make revolutions.}}$$

Substituting the values obtained we have

$$\frac{5 \times 3600 \times .25}{93.5} = 48 \text{ Watts core loss of the transformer.}$$

The greater the number of revolutions the more accurate the results will be by this method.

Several readings should be taken and the average used as the correct reading.

Any reliable make of recording wattmeter may be used for this test. The formula for obtaining watts will be found in instruction book accompanying such meter.

Testing for Copper Loss by Resistance Method.

When the resistances of the primary and secondary coils are known, the copper loss may be calculated for any load on the transformer.

Probably the best and most often used method of determining the resistance is by the "fall of potential" method (see Fig. 4), using direct current instruments and either storage batteries of a sufficient capacity, or a direct current generator. In this method the current I, and the voltage E, are observed, and the resistance R, calculated from Ohm's law $I = \frac{E}{R}$

The copper loss by above method will be the sum of the I^2R losses of both primary and secondary windings.

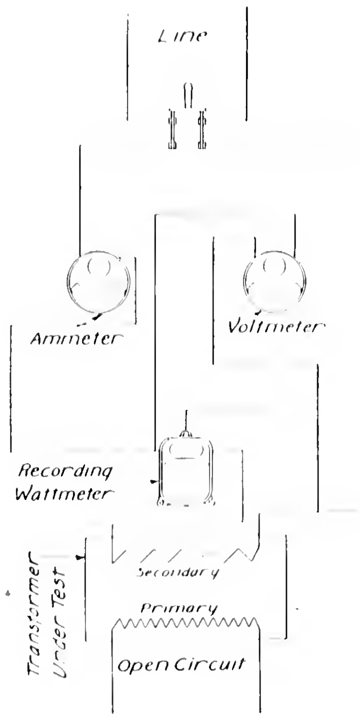


Fig. 3—Connections for Core Loss Test, Second Method.

The current for any transformer may be determined by the following:

$$\text{Current} = \frac{\text{Capacity of transformer in watts}}{\text{Rated voltage.}}$$

For example, we will take a 5 K. W. transformer rated 1100/2200 volts primary, 110/220 volts secondary. Therefore,

the primary current on a 2200-volt primary connection will be

$$\frac{5000 \text{ (watts)}}{2200 \text{ (volts)}} = 2.27 \text{ (amp.)}$$

and the secondary current on a 220-volt connection will be

$$\frac{5000 \text{ (watts)}}{220 \text{ (volts)}} = 22.7 \text{ (amp.)}$$

Assuming the primary resistance to be 8 ohms, and the secondary resistance to be .09 ohms, the copper loss by resistance will be as follows:

Primary $= 2.27^2 =$ (amp.) x 8 (ohms) $= 41.2$ watts.
Secondary $= 22.7^2 =$ (amp.) x .09 (ohms) $= 46.4$ watts.

Total 87.6 watts.

Therefore, the copper loss at full load on a 5 K. W. transformer is approximately 88 watts. Knowing the core loss, which is constant at all loads, the efficiency of the transformer can be easily calculated, as is shown later.

Testing for Copper Loss by Wattmeter.

The copper loss by wattmeter includes eddy currents due to the cutting of the windings by the leakage flux, therefore, the copper loss by wattmeter will be slightly higher than the I^2R loss measured by the fall-of-potential method in a well designed transformer. When conductors are not sufficiently subdivided the eddy currents in same will be very large.

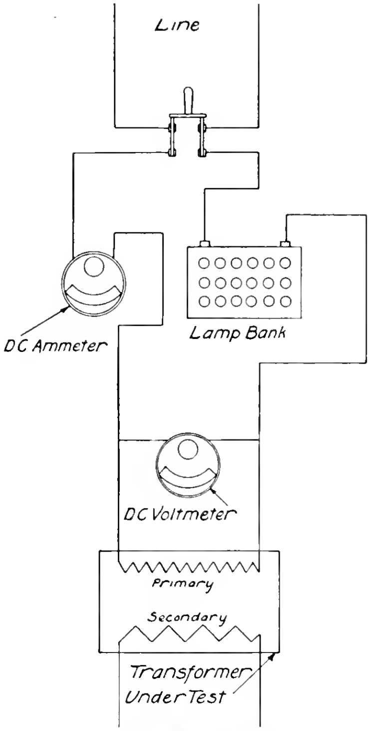


Fig. 4—Connections for Resistance Test.

If to this loss be added the core loss, the efficiency and the total losses may be determined for each load.

The connections for this test are shown in Fig. 5. This test should be taken preferably on the primary side with secondary winding short circuited and with full load current in the windings.

Care should be taken in short circuiting the secondary to have as good contacts as possible, and connecting cables as short as possible.

A recording wattmeter may be used for this test by the same method as that previously described under core loss.

Testing for Impedance.

The impedance of the A. C. circuits corresponds to the resistance of D. C. circuits, and is usually expressed in impedance volts.

The impedance volts is the pressure required to force full load current through either winding with the other short circuited.

The impedance volts may be measured by volt meter connected as in Fig 5. This voltage should be measured with full load current flowing in both primary and secondary.

The impedance voltage varies from 2% to 6% of the rated primary voltage of the transformer under test.

Where there is no variable resistance to be had, as shown in Fig. 5, a simple method of obtaining the per cent impedance is as follows:

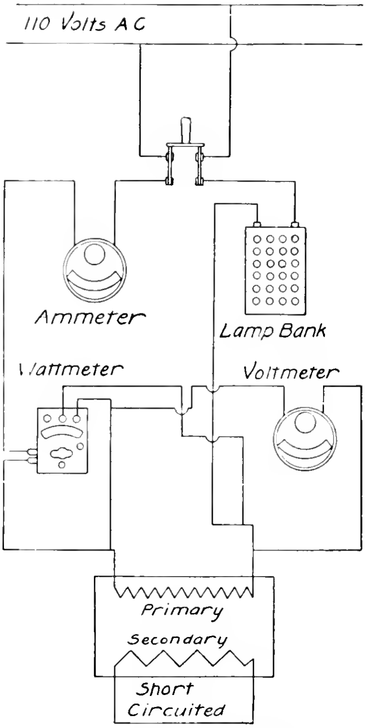


Fig. 5—Connections to Test for Impedance Watts and Volts.

Short circuit the secondary of the transformer through an ammeter (which should be of sufficient capacity to take care of at least 200% of secondary full load current) and to the primary winding apply a pressure of 110 volts (alternating current). Both windings should be connected for their highest voltage in above test.

The per cent impedance will then be:

$$\frac{\text{Pressure applied to primary winding}}{\text{Rated primary voltage x per cent of load as shown by ammeter}} = \text{Per cent Impedance}$$

(To be Continued.)

CURRENT COMMENT

Electric railway mileage in the United States exceeds 38,000. There are 776 miles of street railway operated by cables, steam or horses.

Municipal ownership is prevalent in Germany. Of the 60 cities with a population of 50,000 or more, 44 own and operate gas works, 38 operate electric light plants, 43 have municipal water works and 10 have their own street railways.

Exhaust steam is being brought from iron works in the north of England to run low-pressure turbines in small power plants near the works. Electric current is delivered to the power lines and the condensed steam returned to the works.

Solar magnetism is an accompaniment of spots on the sun, and their appearance have a direct influence of the strength of the earth's magnetism. As a result of work at the Carnegie Solar Observatory at Mount Wilson, George E. Hale has estimated the magnetic intensity of these spots at 2900 C. G. S. units.

A magnetic scrubber has been devised to clean iron ship hulls. The brush bristles are held closely to the hull by an electro magnet mounted on the brush support and the scrubber is dragged back and forth by a steam winch. A vessel can thus be entirely freed from marine growths in a very short time.

Coal available and easily accessible in the United States aggregates 1,463,800,000,000 tons, according to a report from the section of minerals of the National Conservation Commission. At the present increasing rate of production this supply will approach exhaustion before the middle of the next century. From the beginning of coal mining in this country down to the close of 1907, 6,865,000,000 tons have been mined.

Examination for civil and hydraulic engineer in the Reclamation Service is announced by the United States Civil Service Commission on February 3, 1909, at salaries ranging from $175 to $350 a month. These positions are for service in the western part of the United States. The positions to be filled require the exercise of talent in design and ripe experience in construction and administration. The examination will consist of education, experience and achievement.

An electric deep-sea sounder has been recently invented in Germany. It consists of a glass tube containing two resistance wires which may be short-circuited by a column of mercury contained in a box with flexible sides like an aneroid barometer. As the apparatus is lowered in the water drives the mercury higher and short circuits a certain length of the wire resistances. By means of a bridge arrangement the depth is read from the calibrations.

Electric drive of machine tools in the Missouri state penitentiary has greatly simplified operation and dispensed with the services of twenty five convicts concerned with the operation of the former steam plant. In the prison there are six shoe factories, one twine factory, one broom factory, one clothing factory, one saddle-tree factory, one harness shop and a machine shop, each of which was formerly driven by a steam engine. With the old system 900 horsepower was required, while the new takes but 750.

Old Thomson-Houston employees, previous to the company's absorption by the General Electric Company, will hold a reunion in Chicago during the Electrical Show, the date of the reunion being January 28th. They expect to spend the day in visiting the show, and gossiping about old times and they will have a banquet in the evening and experience meeting. This reunion is in charge of the following committee: George Cutler, South Bend (chairman); H. L. Monroe, Monadnock Block, Chicago; P. H. Korst, Janesville, Wis.; George P. Nichols, Old Colony Building, Chicago; I. E. Price, Canton, Ill. All old T.-H. men intending to visit Chicago at this time and attend this reunion will please notify a member of the committee.

Examination for superintendent of construction is announced by the United States Civil Service Commission on February 3-4, 1909, at salaries ranging from $1,600 to $2,500 per annum. The examination will consist of materials and building construction, involving extensive knowledge of all materials employed in first-class buildings and of details of construction; arithmetic; building supervison (tests in the form of business communications which require adaptability and a knowledge of the qualifications necessary for this position and knowledge of the work gained by experience), specifications (involving knowledge of the details of complete specifications for the various classes of work required in first class buildings); training and experience. Applicants must indicate in their applications that they have had at least five years of practical experience in building construction, either as a superintendent proper, contractor, architect, or engineer, and must establish this experience to the satisfaction of the Commission prior to being admitted to the examination.

The copper production in 1908 has been ascertained by L. C. Graton of the United States Geological Survey, through personal interviews and telegraphic communication during the last days of the year. Except one small company, all producers of blister and Lake copper have furnished their latest exact figures, in most cases for eleven months, together with estimates of their production for the remainder of the year. If these estimates are realized, the production of blister and Lake copper in 1908 from ores mined in the United States, will be greater by about 50,000,000 pounds, or between 5 and 6 per cent, than that in 1907, which was 868,996,491 pounds. It is wholly impossible at this time to publish figures of state production that are reliable, but it may be stated concerning the three great copper-producing states, that Arizona and Montana show large gains and Michigan shows little change from 1907. Production of total refined new copper by works in this country cannot yet be given, but probably it will hardly equal the output of 1907, which was 1,032,516,217 pounds. Based on records of the Bureau of Statistics covering the first eleven months, the 1908 imports of copper in pigs, bars, etc., are estimated at about 160,000,000 pounds and in ore and matte at about 53,000,000 pounds. With addition for copper in pyrite, not included above, the total imports may be estimated as equivalent to about 210,000,000 pounds refined copper, a decrease of about 13 per cent from 238,031,320 pounds in 1907. On a similar basis the exports of metallic copper are estimated at about 660,000,000 pounds, the largest ever recorded, and an increase of about 30 per cent over the 508,929,401 pounds exported in 1907. Stocks of refined copper are still undoubtedly very large. Domestic consumption of new copper will show a decline from the 185,000,000 pounds of 1907. The average quoted price of electrolytic copper at New York for 1908 was 13.20 cents. The price at the close of the year was 14.18 cents. The prospect is bright at the present for a still larger copper production in the year 1909, but it is evident that the principal producers will, more than in recent years, gage their operations by the consumption of the metal, which cannot at this time be safely forecasted.

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FOUNDED 1887 AS THE
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CONTENTS

Pure Food for the Boiler.

The other day an engineer said: "If I had to put a farmer in charge of a steam power plant, I would tell him to handle it like a racehorse, and it would probably get better treatment that it gets from the average fireman." There is a lot more sense in this statement than is at first evident. Some people take better care of their horses and dogs than they do of themselves. They are the chief gainers by the recent crusade against patent medicines which culminated in the National Food and Drug Act of 1907 and aroused the public to the many deceptions which are practiced and the worthless preparations for domestic use which are on the market. It puts them on their guard against dosing their system into sickness.

A similar educative campaign about the patent medicines which are being fed into power plant systems would not be amiss. There are as many secret remedies for boiler troubles as there are for liver complaints. The average engineer is no more in a position to judge their value than is the housewife able to decide between a valuable and a worthless proprietary medicine. Many of the panaceas for all the ills to which the boiler is heir are rank impositions. A certain fancy-priced alloy guaranteed to prevent corrosion or pitting of boilers is nothing but feathered zinc. Untruthful statements are made about unworthy preparations, and the worthy are often so adulterated as to be of little use. Paints, oils, varnishes, boiler compounds, lubricating oils and metals are diluted with cheap substitutes often worse than useless.

The intelligent engineer is wary. He buys from reliable firms on rigid specifications. He knows that the chemist can tell him if he is not getting what he is paying for. He has learnt that he can remove the properties of hard water which cause boiler scale and chemical corrosion. He understands that fuel should be bought, not by the ton, but by its heating capacity as determined by analysis. Finally, if he finds that the water is not getting all the heat it should, he is not afraid to call in an expert who will analyze the chimney gases and find if the fuel is burning right. When a horse gets sick we send for the horse-doctor; when a boiler is not acting right, the chemist can usually remedy it.

It is only the unprogressive engineer who needs protection against his susceptibility to the glib arguments of the smooth-tongued salesman. For him there should be some governmental regulation against improper labelling and fraudulent preparations. Until such legislation is enacted it behooves the owner of the power plant to see that his engineer is properly instructed and not made a dupe because of ignorance.

PERSONAL.

E. C. Gaumnitz, purchasing agent for the Seattle Electric Company, is in San Francisco.

W. A. Blair, assistant treasurer of the Western Electric Company of San Francisco, spent the past week in Los Angeles.

G. A. Knoche, manager of the Electrical Department of Dunham, Carrigan, Hayden Company, San Francisco, returned this week from an extended trip through the East.

T. E. Droham, St. Paul representative of the Northern Electrical Mfg. Co., announces the enlargement and removal of the company's offices to 1046 Security Bank Building, Minneapolis, Minn.

C. W. Hutton has resigned as superintendent of the Sacramento Power Division of the Pacific Gas and Electric Company after nearly thirteen years continuous service, and has accepted the position of Engineer of Operation and Maintenance for the Great Western Power Company, with headquarters at Sacramento.

T. E. Bibbins, of the San Francisco office of the General Electric Company, accompanied by Mrs. Bibbins, made a trip to Los Angeles last week in conjunction with Mr. F. G. Vaughen and Mr. G. C. Osborne, of the Eastern organization of that company, where an inspection of the work of the local sales organization was made. Mr. and Mrs. Bibbins returned early this week after a very pleasant trip.

Oliver L. Williams has recently joined the forces of Pierson, Roeding & Co. as manager of their car department. Pierson, Roeding & Co. are the Coast representatives of the J. G. Brill Company and their allied plants, and Mr. Williams will bring to this department a long experience with cars, trucks and supplies. He was for several years in the Brill Company's truck department, later car inspector for the firm of Ford, Bacon & Davis of New York City, and thereafter expert in the truck department and assistant in the selling department for the well known Peckham Truck Company.

PRESENT CONDITION OF COUNTRY'S FOREST RESOURCES.

Few people have anything like a clear idea of the amount of forest wealth left in this country. Those who think at all about this natural resource which has assisted in material development since the landing of the first settlers are usually too much influenced by the condition of that perticular state or section in which they are most familiar.

If they live in a much deforested or a treeless region, the people usually imagine that the country's timber supply is even more limited than is actually the fact; on the other hand, with those whose homes are located in a section where a pinch in timber has not been experienced, the feeling is likely to be altogether the other way, and some become so indifferent at times as to think that there is really not much reason to worry about the timber problem. Both can profit by a reading of the actual facts.

The forests of the United States now cover about 550 million acres, or about one-fourth of the land of the whole country. The original forests covered not less than 850 million acres, or nearly one-half.

The forests owned by the government cover one-fourth of the total forest area, and contain one-fifth of all timber standing. Forests privately owned cover three-fourths of the area, and contain four-fifths of the standing timber. Besides having three times the area and four times the forests, the timberland privately owned is generally more valuable.

Forestry, or conservative lumbering, is practiced on 70 per cent of the forests publicly owned and on less than one per cent of the forests privately owned. This covers the country's forest resources as they stand to-day. Senator Smoot, chairman of the section of forests of the National Conservation Commission, in outlining the future has said:

"By reasonable thrift, we can produce a constant timber supply beyond our present need, and with it conserve the usefulness of our streams for irrigation, water supply, navigation, and power.

"Under right management, our forests will yield over four times as much as now. We can reduce waste in the woods and in the mill at least one-third, with present as well as future profit. We can perpetuate the naval stores industry. Preservative treatment will reduce by one-fifth the quantity of timber used in the water or in the ground. We can practically stop forest fires at a total yearly cost of one-fifth the value of the standing timber burned each year, not counting the young growth.

"We shall suffer for timber to meet our needs, until our forests have had time to grow again. But if we act vigorously and at once we shall escape timber scarcity."

TRADE CATALOGUES.

A handsome calendar with large numbers has been issued by the Railway Equipment Company of 72-74 First Street, Portland, Oregon.

The Eck Dynamo and Motor Co., of Belleville, N. J., send a neat sectional catalogue and data book. Bulletin No. 39 illustrates and describes their protected type of Direct Current dynamos, belt drive, for lighting and power. Bulletin No. 40 is devoted to protected and enclosed types of Direct Current.

Bulletin No. 5910 from the Western Electric Co., is entitled Electrical Equipment for Central Stations. It includes an account of the company's facilities for this work illustrations and descriptions of their a. c. and d. c. generators, Western Electric arc lamps and switchboards. Appended is a long list of light and power stations using Western Electric apparatus.

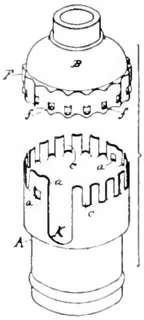
Bulletin No. 4628, just issued by the General Electric Company, describes the company's new Mercury Arc Rectifier which is an improvement over the older design, inasmuch as it possesses all the good features of that design and, in addition, advantages not combined in any other device for converting alternating current to direct current in capacities up to and including 40 amperes.

The bulletin goes into details and illustrates and describes the standard commercial rectifier set, ignition battery charging outfit, small-motor rectifier panel, outfit for moving picture machines, and a garage outfit, that contains also dimension diagrams and other data.

A new catalogue entitled "Pipe and Boiler Insulation," has just been issued by the H. W. Johns-Manville Co., of New York. This book is devoted to a thorough presentation of the problems of insulating all kinds of heated and cooled surfaces, such as pipes, boilers, furnaces, flues, ducts, etc., as well as insulation for refrigerating and cold storage work. The book is the most complete one its kind ever issued to the trade and bears out the company's idea, "a covering for every condition." It is very handsomely illustrated and printed throughout. A copy of the catalog can be secured by addressing the company's nearest branch and asking for Catalog No. 100.

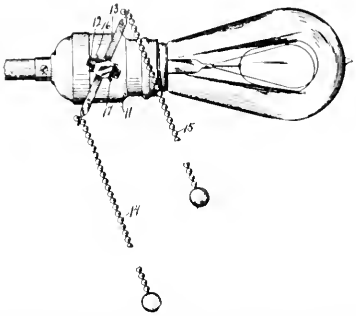
PATENTS

907,782. Incandescent-Electric-Lamp Socket. Gilbert W. Goodridge, Bridgeport, Conn., assignor to The Bryant Electric Company, Bridgeport, Conn. An incandescent lamp socket having a cap with projections on the flange many times repeated symmetrically around the circumference of the cap



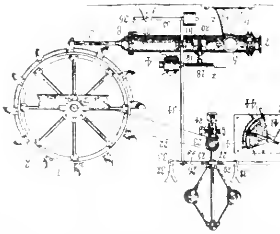
in combination with a shell having openings and open notches also symmetrically arranged around its circumference, some of the projections on the cap latching with said openings and the other projections entering the notches.

907,770. Electric-Light Switch. Walter W. Fulton, Chicago, Ill. In combination, a spring clip having arms adapted to embrace the flattened T head of an electrical switch key



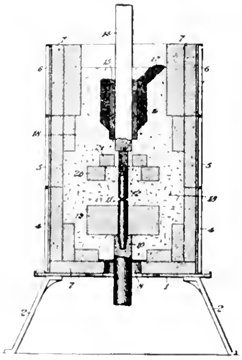
from end to end, each arm of the clip being apertured to receive one end of the key head, a crank arm carried by the clip, and a pendant cord carried by the crank arm.

907,725. Regulator for Tangential Water-Wheels. James M. Boyle and Frank W. Roller, New York, N. Y. In combination with a tangential water wheel and a device for de-



livering a jet to the bucket thereof, means governed by variations in speed of said wheel for deflecting said jet and electrically actuated mechanism governed by said speed variation for changing the cross-sectional area of said jet.

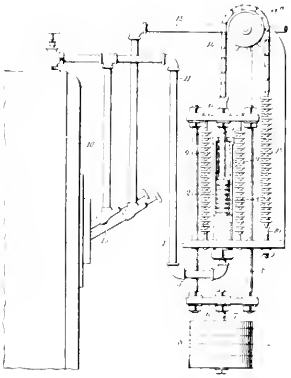
908,130. Method of Producing Silicon. Henry N. Potter, New Rochelle, N. Y., assignor to Geo. Westinghouse, Pittsburg, Pa. The method of producing silicon by the reduction of silica in the presence of silicon carbid, the collection of



fluid silicon and any contained silicon carbid upon a silica bed and the oxidation of the carbon of the contained silicon carbid by reaction with the said bed.

907,712. Protected High-Potential Rail. Albert H. Armstrong, Schenectady, N. Y., assignor to General Electric Company. In combination, a third rail, a conductor, a protective covering for said third rail, and an electrical connection including a resistance between said covering and the return conductor.

908,179. Fuel-Regulator. Charles B. Wieser and Frank E. Wieser, Paso Robles, Cal., assignors of one-third to James M. Currell, Paso Robles, Cal. The combination of a burner, a fuel supply leading to the burner, having a regulating valve, a cylinder, rods slidable relatively to the cylinder having



heads attached to its opposite ends, a piston in the cylinder connected to one of said heads, a wheel for operating said valve, a flexible member, connected at one end to the piston and passing over the wheel, means independent of said wheel and connected to the opposite end of said member, tending to move it in a direction to cut off the fuel supply, and means tending to move said member in the opposite direction.

INDUSTRIAL

ANNUAL CONFERENCE SALES DEPARTMENT H. W. JOHNS-MANVILLE COMPANY.

In accordance with the usual custom the H. W. Johns-Manville Company held its annual salesmen's conventions at their various branch offices on December 29th and 30th. The convention in San Francisco participated in by about twenty-five members of their staff was particularly successful, the papers presented showing the result of careful training and an intimate acquaintance with the various subjects discussed.

Through the courtesy of the local management several of these papers will be published in early issues of the JOURNAL OF ELECTRICITY giving our readers an opportunity to secure the benefit of them.

The following program was carried out.

December 29th

10:30 A. M. OPENING REMARKS

C. W. SCOTT, Manager.

Pipe Coverings.

Economy of covering steam heated surfaces, whether coal or oil fuel used. Kinds of covering for different conditions .... S. P. RUSSELL

Experiences Among Architects and Engineers

How to gain their confidence....... L. W. BLANKMAN

Introducing Indurated Fibre Specialties to the Steam Fitter

How to gain and hold his trade....... W. I. TAYLOR

Discussion.

Our Specialties

What I have done with this line.. .F. P. MONTGOMERY

Cements

Kinds and uses for all heated conditions. Leak No and H-O. How to apply .... C. H. McCALL

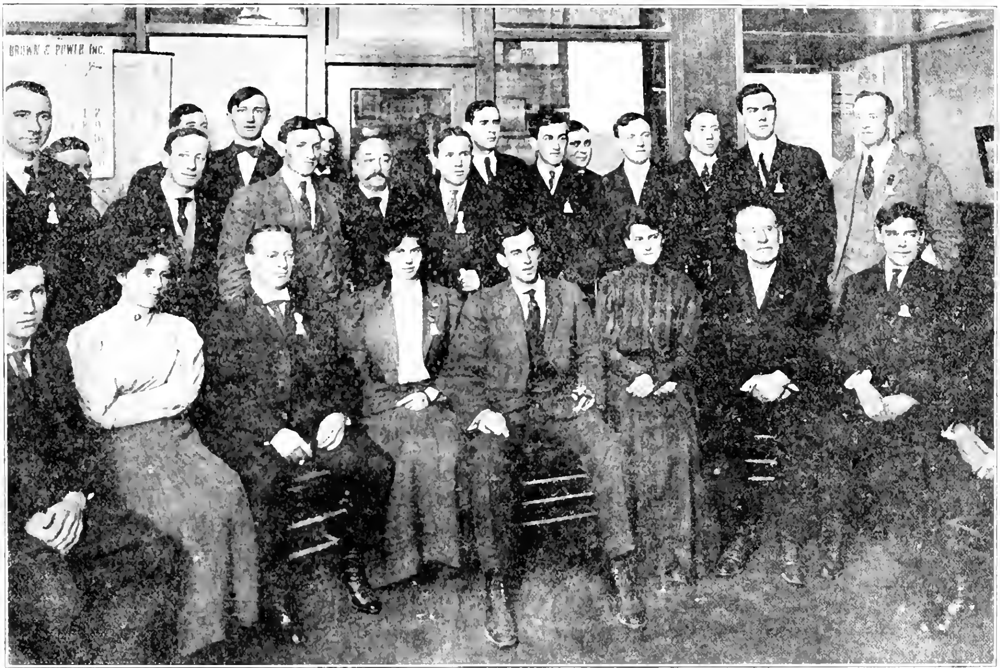
Discussion

Packings

Soft and Metallic Packings—how used and sold. Experience of thirty years with salesmen, from a buyer's point of view .... JOHN A. JONES

How to Measure Stuffing Box and Rod and Pack Pumps

A practical demonstration with a model pump. ED. F. JONES



San Francisco Staff of H. W. Johns-Manville Co.

General Packing Conditions Afloat and Ashore

.... W. R. JONES

How to Install Metallic Packing

.... R. J. JONES

December 30th

10:00 A. M.

Electrical

How general salesman can help this department. Lines he can handle .... S. P. RUSSELL

Linolite and Tungsten Lamps

.... F. S. MILLS

Discussion

Cold Storage

Keystone Hair Insulator vs. Cork, Hair Felt and Mineral Wool. Relative efficiency .... J. H. DAVELER

Discussion

Boiler Compound and Some Feats of "Magic" it has performed .... CHAS. M. THURSTON

Roofings

Asbestos vs. Organic Roofings, as told by "The Man with Torch" .... C. L. HILL

Water Proofing and Damp Proofing
...H. E. ZABEL

Discussion

Keystone vs. Cabots Quilt and Linofelt

Methods of sound deadening and insulating apartments, flats, etc. How the Mail Order Department has sold Keystone, General Circularizing.........C. H. McCALL

Pointer Department

Methods employed, and how used for the benefit of the salesmen. Value of systematic daily reports, producing results ....C. W. SCOTT

Discussion

Accounting Department

Why serious consideration should be given financial standing of customer by salesmen. Why, under certain conditions, salesmen should collect accounts.

ORDERS. How written, signed and other features necessary for universal satisfaction on part of buyer and seller ....O. M. BRYANT

GRANT FLAMING ARC.

The flaming arc is fast revolutionizing all that department of illumination to which arc lighting is applicable. Its superiority over the ordinary arc consists in the color of the light, the absence of shadows, far greater brilliancy, and economy of current consumption.

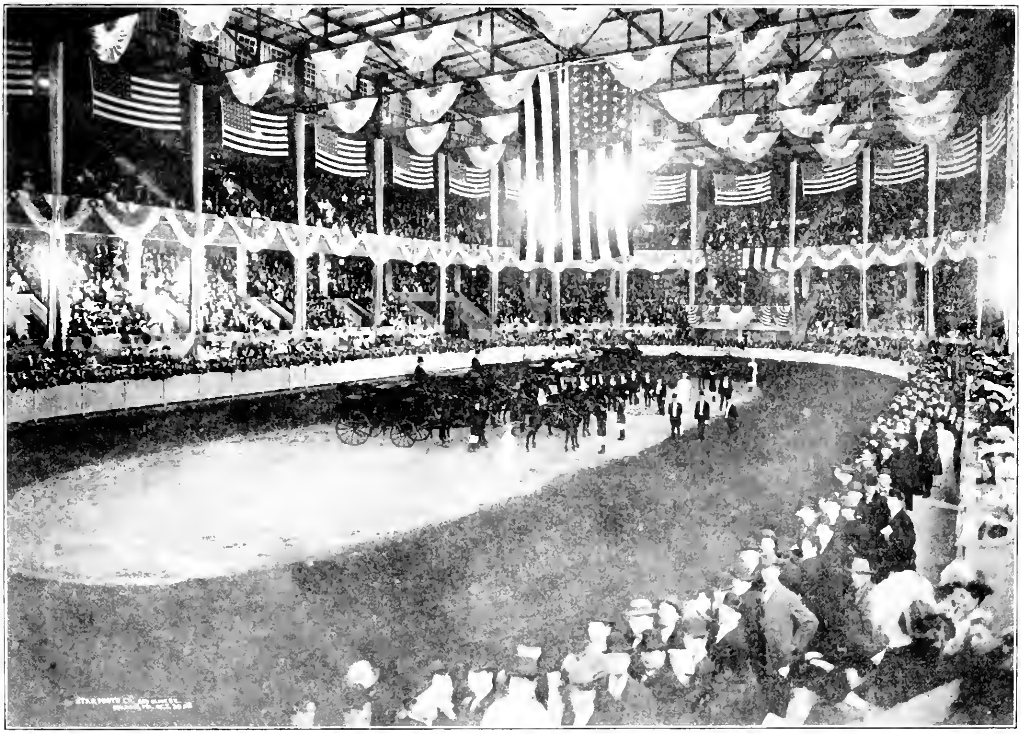
The economy of the flaming arc can best be illustrated by the following tables:

Relative candle-power for 1200 Watts:

	Candle-power
24 16 candle-power incandescent lamps.....	384
2 Enclosed Arcs	600
2 Flaming Arcs..........................	6,000

To develop 6,000 candle-power requires:

	Consumption K. W.
375 16 candle-power incandescent lamps....	18.75
20 Enclosed Arcs	12.
2 Flaming Arcs..........................	1.2



Illumination of St. Louis Coliseum With Grant Flaming Arc.

The proceedings ended very happily with a banquet held in the college room of the Bismarck Cafe on the evening of December 30th where science was for the time being set to one side and goodfellowship was permitted to establish a basis for team work during the coming year.

One of the memorable incidents of the conference was the presentation to Mr. C. W. Scott, manager, by the employees, of a handsome watch fob properly inscribed, the presentation being made by Mr Walter Jones Mr. Scott's well known reputation as a ready speaker was very badly shattered, as he was taken entirely by surprise and at a loss for words to express the deep appreciation he felt The very successful session ended with the newly inaugurated "sales yell"—

"All together, All the time.
For everything Johns-Manville."

Allowing an efficiency of 100 per cent to the flaming arc, ordinary enclosed arcs have only 10 per cent, and incandescent lamps 8 per cent efficiency. The difference in brilliancy of the two kinds of arcs is due to the fact that in the ordinary arc the light is produced by the combustion of the carbon itself, which is a poor radiator, while in the flaming arc the space between the ends of the carbons is filled with a substance liberated from the carbons by the electric current, the combustion of which produces a flame of intense brilliancy with powerful radiating qualities. The globe presents the appearance of a solid ball of flame, and the light is diffused so uniformly that no heavy shadows are cast. It is practically flickerless. A room containing 10,000 square feet of floor space is so well lighted by one Grant lamp that a newspaper can be read in every part. The Grant lamp is ex-

ceptionally compact, neat and attractive in appearance, the absence of differential mechanism considerably reducing the bulk. It weighs but twenty pounds; and although only twenty-six inches long, will carry 24-inch carbons. The short-hour Grant lamp is shorter than the regular form of enclosed arc. The Grant is of the gravity feed type, substantially built, and practically frictionless. The number of insulated parts is reduced to a minimum, and mica and lava only are used whenever insulation is necessary, thereby eliminating all trouble caused by defective insulation. All parts are made to standard gauge and are interchangeable.

The carbons are held by means of a lateral support above the arc, which is one of the features for which patents are pending. There is, therefore, no obstruction below the arc, and no shadow. The feed is accomplished smoothly and regularly, and is almost imperceptible. No special make of carbon is required; but as there are several kinds of flaming carbons on the market, some of which are of inferior grade, it is advisable to order carbons from us to ensure perfect operation of the lamp.

The arc is struck and maintained by means of a floating plunger, which corresponds with the variations of the arc, thereby preventing the see-sawing so noticeable at times in lamps of existing types. The arc blows straight down, and

Grant Flaming Arc Lamp.

does not run around the rim of the crater as in the ordinary arc.

The most economical operation of the Grant lamp is obtained by burning two in series on line voltages of from 100 to 120, or four in series on line voltage of from 200 to 240. Individual or multiple lamps are supplied at small extra cost with a resistance for the direct current hanging directly over the lamp.

The Grant is the ideal illumination for streets, ferries, docks, railroad yards, excavations, foundries, factories, exteriors of stores, and is a very effective advertising medium.

It is also unequalled for illuminating large interiors, such as public halls, armories, rinks, and places of amusement. For exterior use carbons giving rays of a golden hue are used; carbons giving a pearl white light are often preferred for interiors.

The Grant is manufactured for both direct and alternating current, and in two standard types; type "A" burns ten hours, type "B" burns seventeen hours. Fig. (1) shows the Grant lamp with japanned case, but any finish will be furnished to suit the customer. Fig. (2) shows the Grant lamp installed at the Coliseum in St. Louis at the Horse Show; twenty-six lamps are used to illuminate the building.

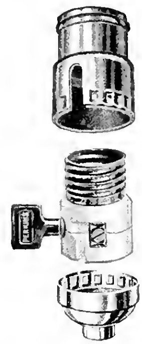
The Grant flaming arc is installed on two-thirds of the steamship piers in New York; among the notable users are:

White Star Line piers, New York; Cunard Line piers, New York; Wilson Line piers, New York; Royal Mail S. S. Co. piers, New York; Italian Line piers, New York; Metropolitan S. S. Co. piers, New York; Clyde Line piers, New York; Quebec Line piers, New York; Mallory Line piers, New York; Southern Pacific S. S. Co. piers, New York; Barber Line piers, Brooklyn, N. Y.; John N. Robbins Dry Dock Co., Brooklyn, N. Y.

The Grant Flaming Arc Lamp can be seen at 560 Pacific Building, San Francisco, the office of the company. The company has been recently incorporated and organized in California to handle this lamp on the Coast. The officers of the company are C. C. Manker, president and manager; J. W. Manker, vice-president and treasurer; and H. C. Skinner, secretary. The company has been incorporated for $25,000 under the laws of the State, with five directors, C. C. Manker, J. W Manker, H C. Skinner, Henry Mallock, and A. E. Wood.

THE "NEW WRINKLE" SOCKET.

The Perkins "New Wrinkle" socket illustrated herewith marked a new idea in socket construction. Its ingenious method of attaching cap and shell made it especially adaptable for fixture and pendant work. This socket has recently



been further improved by surrounding the cap with a thin band of brass which conceals the corrugations and perforations. This therefore gives a smooth, beautifully finished surface with nothing to mar its symmetry, nor to jar with the design of any fixtures, no matter how ornate or how simple.

BENJAMIN HAND PORTABLE LAMP.

It is a matter of common knowledge among electrical men that the use of bare lamps or wire guards is a source of considerable danger to both workmen and machinery because of the liability to short circuits or grounds. Many a man has lost his life and many a motor or generator has been destroyed by contact with live wires. The Benjamin Electric Manufacturing Company, of 42 West Jackson Boulevard, Chicago, have placed upon the market a fiber hand portable, which renders such accidents impossible. The value of this device is such that those familiar with electrical machinery and the risk attendant upon the working around it will require no further comment to convince them of its merits. There are no metallic parts, and the construction is such that the distribution of light is as free as that of any ordinary guard.

NEWS NOTES

TRANSMISSION.

YREKA, CAL.—F. H. Osgood and M. H. Balfry have filed claim to 1,000 inches of water in Nigger Creek for electrical and other purposes.

OROVILLE, CAL.—The Oro Water, Light and Power Co. is running a power line through the Central House and Honcut sections to supply power for several pumping plants.

SAN ANDREAS, CAL.—The Mokelumne River Power and Water Co. has filed claim to 5,000 inches of water of the south branch of the Middle Fork of the Mokelumne river, to be diverted at Cadish.

BOCA, CAL.—A new electric light plant has been constructed and newly equipped here by the Union Ice Company. The new plant has been constructed to supplant the company's old plant which was destroyed by fire a short time ago.

EL CENTRO, CAL.—Work has been begun in the construction of the Holton Power Company's plant at Holtville, three carloads of material for the plant having already been received, while eight carloads of machinery are on the road from Pennsylvania.

RENO, NEV.—F. G. Baum, president of the California-Nevada Power Company, announces that the Reno Power, Light and Water Company is to be taken over by a new company in which London capitalists will be largely interested. It is announced that the new company contemplates making many improvements.

BERKELEY, CAL.—The Pacific Gas and Electric Co. will soon begin the erection in this city of a new power station to cost in the neighborhood of $100,000. This plant will be used for the "tying in" of the low tension feed wires and will do away with the necessity of the high power wires which now run through the city. The transformer station on the Berkeley hills has been completed.

SAN FRANCISCO, CAL.—The Owens Water and Power Co. and the Nevada-California Power Company are contending for rights of way through a canyon on the eastern side of the Inyo forest reserve, the matter now being before the Forest Service for a decision. Applications for right of way were filed by both companies in 1907. The Nevada-California Company constructed its line soon after and this is now in operation to Goldfield and Tonopah, Nevada. The Owens River Company has done no construction, and it asserts that the application of the rival company for permission to construct a second line through the canyon will result in serious trouble, owing to the narrowness of the canyon.

ILLUMINATION.

GALLUP, NEW MEXICO.—Bids will be received by the Board of Trustees of this place for the furnishing of street lights.

YERINGTON, NEV.—A number of Carson, Nev., capitalists have been looking over the ground here with an eye to erecting a gas plant.

STOCKTON, CAL.—Bids for a franchise for the supplying of electric power to this city will be received by the City Council up to February 8th.

SAN DIEGO, CAL.—A stockholder's meeting of the San Diego Gas Company will be held on February 17th, at which time the matter of an increase of the capital stock to $3,500,000 from $1,500,000 will be voted on. Superintendent Clark of the company announces that another holder with 1,000,000 cubic feet capacity will have to be built next year.

EL CENTRO, CAL.—Plans have been prepared for the main plant of the Imperial Valley Gas Company, which will be located in the angle formed by the Southern Pacific and the Holten Interurban railroads. It is expected that gas service will be in readiness before summer.

TRANSPORTATION.

CITY OF MEXICO, MEXICO.—The Tramways Company will begin at once the electrification of its Penon line, which at present is being operated by mule cars.

LOS ANGELES, CAL.—An application for an electric railway franchise to the western part of the city has been received by the Board of Supervisors and ordered published.

VALLEJO, CAL.—San Francisco, Vallejo and Napa Electric Railroad has already completed more than a mile of its road north of St. Helena and plans to have cars running into Calistoga by early summer.

SACRAMENTO, CAL.—Work on the proposed Oroville and Fair Oaks Electric Railway will in all probability be begun about the middle of April. The road will have a terminal south of the mouth of the American River, a tract of about seventy acres with good river frontage having been secured.

LONG BEACH, CAL.—Superintendent McMillan of the Pacific Electric Railway, states that his company will build a short connecting link of track between this city and West Long Beach and operate cars thereon as soon as permission to use the drawbridge of the Salt Lake Railway can be secured.

SAN FRANCISCO, CAL.—At the annual meeting of the directors of the Northwestern Pacific held in this city Edward Chambers and H. K. Gregory, directors representing the Santa Fe, retired from the Board, and were succeeded by Southern Pacific officials, W. R. Scott and C. H. Seger. George L. King was appointed secretary in the place of J. L. Willcutt.

FINANCIAL.

SAN FRANCISCO, CAL.—Suit has been filed here against the Spring Valley Water Company by Assistant City Attorney Haven, who has applied to the United States Circuit Court for a modification of the injunction granted the company to shut off the water of any consumer who declines to pay above the rate set by ordinance by the Supervisors. He has taken the case of an individual consumer, whom the company had threatened to deprive of his supply upon his refusal to pay a 15 per cent excess.

VALLEJO, CAL.—This city has suffered defeat in a suit instituted less than a year ago by Constance Malandrino, who sought an injunction to enjoin the officers of the city from interfering with his pumps on his ranch in Wild Horse Valley, through which the stream supplying the city flows. The complainant also claimed the right to use as much of the water as he wished. The Superior Court decided against the city in every point.

TELEPHONE AND TELEGRAPH.

OROVILLE, CAL.—J. H. Richardson has been granted a franchise to construct and maintain a telephone line from Richardson Springs to Chico.

COLUSA, CAL.—The Colusa County Telephone Company has purchased the business and equipment in Colusa County of the Pacific Telephone & Telegraph Co. The new concern will re-arrange the system.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer — who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

ADAPTERS

LAMP ADAPTERS

Benjamin Electric Mfg. Co.
Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.

ALARMS

BURGLAR ALARMS

Edwards & Co.
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc.
Western Electric Co.

FIRE ALARMS

Edwards & Co.
Western Electric Co.

WATER ALARMS

Partrick, Carter & Wilkins Co.

ANCHORS

Kierulff, B. F. Jr. & Co., "Hubbard."
Klein & Sons, Mathias.

ANNUNCIATORS

Edwards & Co.
Elec. Goods Mfg. Co., "Ross," "Rivol," "Perfect," "Noxall."
Partrick, Carter & Wilkins Co., "King."
Standard Elec. Wks. "C.&S."
Stanley & Patterson, Inc.
Western Electric Co.

ARMS

CROSS ARMS

Kierulff B. F., Jr. & Co.
California Pole & Piling Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

MAST ARMS

Elec. Appliance Co., "Cutter"
Ft. Wayne Electric Works.
Kierulff, B. F., Jr. & Co., "Cutter"
Western Elec. Co., "Fletcher"

TELEPHONE TRANSMITTER ARMS

Dean Electric Co.
Elec. Appliance Co., "Eaco."
Kierulff, B. F., Jr. & Co., "Sterling."
Sterling Elec. Co.
Western Elec. Co.

INDEX TO ADVERTISEMENTS

ASBESTOS

Johns-Manville Co., H. W.

BATTERIES

DRY BATTERIES

Dean Electric Co.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

DRY BATTERY HOLDERS

Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES

Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY

Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

STORAGE BATTERIES

Elec. Storage Battery Co.
Westghse Machine Co.

BELLS

ELECTRIC BELLS

Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

ELECTRO-MECHANICAL GONGS

Edwards & Co.
Electric Goods Mfg. Co.
Marshall Elec. Co.
Partrick, Carter & Wilkins Co.

MAGNETO BELLS

Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

BOILERS

Henshaw-Bulkley & Co.
Keystone Boiler Wks., "Parker."
Moore & Co., Chas. C., "B. & W."
Standard Electrical Works, "Robb-Mumford."
Tracy Engineering Company, "Edge Moor."

BOOKS

Technical Book Shop.

BOXES

WALL BOXES

Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knock-out."
Chicago Fuse Wire & Mfg. Co., "Union."
Cole Co., John R., "Bossert."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B."
General Electric Co.
Harvard Elec. Co.
Holabird-Reynolds Elec. Co.
Marshall Electric Co.
Standard Elect'l Wks., "M & M."
Stanley & Patterson, Inc., "Simplex."

BRACKETS

CEILING BRACKET AND DESK FIXTURES

Stanley & Patterson, Inc., "Sunlight."

DESK TELEPHONE BRACKETS

Stanley & Patterson, Inc., "Imperial."
Sterling Elec. Co. "Equi- . . ."
Western Electric Co

IRON POLE BRACKETS

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co. "Cutter."
Pierson, Roeding & Co.
Western Elec. Co, "Fletcher"

BURNERS

ELECTRIC GAS LIGHTING BURNERS

Electric Goods Mfg. Co., "Advance."
Edwards & Co.
Welsbach Company.
Western Electric Co., "Edwards."

CABLES

SUBMARINE AND LEAD-COVERED

American Electrical Works.
Belden Manufacturing Co.
Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
National Conduit & Cable Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
Standard Electrical Works. "Simplex"
Standard Underground Cable Co.
Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

PAPER INSULATION

Belden Manufacturing Co.
Nat'l. Conduit & Cable Co.
Western Electric Co.

TELEPHONE CABLE

Dean Electric Co.

CARBONS

ARC LIGHT CARBONS

Brooks-Follis Elec. Corp'n, The, "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The, "I-T-E," "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
Kierulff, Jr., & Co., B. F. "Hartman."
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLEATS

FIBRE CLEATS

Blake Signal & Mfg. Co.

PORCELAIN CLEATS

General Electric Co.
Holabird-Reynolds Elec. Co., "Electric Porcelain."
Thomas & Sons Co., R.
Weber Elec. Co., H. D. Sears, general sales agent.
Western Elec. Co., "Thomas"

WOOD KNOBS

Blake Signal & Mfg. Co.

CLUSTERS

FIXTURE CLUSTERS

Benjamin Electric Mfg. Co., "Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbell"

COILS

ARMATURE AND FIELD COILS

Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Deltabeston."
Westghse Elec. & Mfg. Co

INDUCTION COILS

Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co.
Western Electric Co.

SPARK COILS

American Electrical Works.
Electric Goods Mfg. Co.
Western Electric Co.

COMPOUNDS

BOILER COMPOUNDS

Dearborn Drug & Chemical Works.
Johns-Manville Co., H. W., "Magic."

CONDUIT

FLEXIBLE CONDUIT

American Circular Loom Co., "Circular Loom."
Cole Co., John R., "Circular Loom."

RIGID CONDUIT

American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct," "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roeblings Sons Co., J. A "Navalite."
Cole Co., John R., "Electroduct."

UNDERGROUND CONDUIT

Johns-Manville Co., H. W., "J.-M."
Pierson, Roeding & Co., "Fibre."
Roeblings Sons Co., J. A., "Bituminized Fiber."
Walworth & Neville Mfg. Co.
Western Electric Co., Agents Walworth & Neville Mfg. Co

CONDUIT CLAMPS

Krantz, H., Mfg. Co.

CONNECTORS

CABLE CONNECTORS

Belden Manufacturing Co.
Chicago Fuse Wire & Mfg Co.
Harvard Elec. Co.
Kierulff, B. F., Jr. & Co.

CORD

FLEXIBLE BELL CORD

American Electrical Works.
Belden Manufacturing Co.
General Electric Co.
Kierulff, B. F. Jr. & Co., "National."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roebling Sons Co., John A
Simplex Elec. Co.
Western Electric Co.

LAMP CORD

American Electrical Works.
Belden Mfg. Co.
Elec. Appliance Co., "Paranite."
General Electric Co.
Okonite Co., The, "Okonite."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roeblings Sons Co., John A.
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Std. Elec. Wks., "Simplex."
Standard Und. Cable Co.
Western Elec. Co., "Victor."

TELEPHONE CORD

Belden Manufacturing Co.
Dean Electric Co.
Kellogg Sw'b'd & Supply Co
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Standard Elec. Works, "Simplex."
Western Elec. Co., "Victor."

CROSS ARM BRACES

Benicia Iron Works.
Kierulff, B. F., Jr. & Co.

CUT-OUTS

ARC CUT-OUTS

Bryant Electric Co.
Ft. Wayne Electric Works.
General Electric Co.
Perkins Elec. Switch Mfg. Co.
Westghse Elec. & Mfg. Co.

INCANDESCENT CUT-OUTS

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.
Weber Elec. Co., H. D. Sears, general sales agent.
Westghse Elec. & Mfg. Co.

TRANSFORMER CUT-OUTS

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.
Westghse Elec. & Mfg. Co.

DYNAMOS

ALTERNATING CURRENT DYNAMOS

Allis-Chalmers Co., "Bullock."
Fairbanks, Morse & Co.
Ft. Wayne Electric Works.
General Electric Co.
Standard Electrical Works, "E. M. Co."
Western Electric Co.
Westghse Elec. & Mfg. Co.

DIRECT CURRENT DYNAMOS

Allis-Chalmers Co., "Bullock."
Electric Appliance Co., "Colonial."
Fairbanks, Morse & Co.
Ft. Wayne Electric Works.
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works. "E. M. Co."
Western Electric Co.
Westghse Elec. & Mfg. Co.

ELEVATORS

Van Emon Elevator Co.

ENGINES

GAS AND GASOLINE ENGINES

Allis-Chalmers Co.
Moore & Co., Chas. C.
Fairbanks, Morse & Co.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Kierulff, B. F., Jr. & Co., "American Diesel Engine."
Tracy Engineering Co.
Westghse Machine Co.

DESK AND BRACKET DIRECT CURRENT FANS

Electric Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co., "G. E."
Standard Electrical Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

CEILING, ALTERNATING CURRENT FANS

Standard Elec. Wks., "Jandus." "Century."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

CEILING, DIRECT CURRENT FANS

Electric Appliance Co., "Colonial."
Standard Elec. Wks., "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

MARINE ENGINES

Standard Elec. Works, "Engbery."

STEAM ENGINES

Allis-Chalmers Co.
Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Tracy Engineering Co., The
Westghse Machine Co.

FANS

DESK AND BRACKET ALTERNATING CURRENT FANS

Ft. Wayne Electrical Works.
General Electric Co., "G. E."
Standard Electrical Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

EXHAUST FANS

General Electric Co.
Standard Elec. Wks., "M. A. Co."
Wagner Electric Mfg. Co.
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co.

FIXTURES

CEILING, BRACKET AND DESK FIXTURES

Benjamin Electric Mfg. Co.
Dale Co.

MARINE FIXTURES

Benjamin Electric Mfg. Co.
Dale Co.
Electric Appliance Co.
Sterling Electric Co.

SHOW CASE FIXTURES

Benjamin Electric Mfg. Co.
Dale Co.
Johns-Manville Co., H. W., "Linolite."

STAGE FIXTURES

Chase-Shawmut Co., "Shawmut."

FUSE MATERIAL

ENCLOSED FUSES AND FITTINGS

Bryant Electric Co.
Chase-Shawmut Co., "Shawmut."
Chicago Fuse Wire Mfg. Co., "Union."
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W., "Noark."
Marshall Electric Co.
Perkins Elec. Switch Mfg. Co.
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

FUSE BOXES

Including Service Boxes, Subway Boxes and Junction Cut Outs for use with enclosed fuses.
D. & W. Fuse Co., "D. & W."
Johns-Manville Co., H. W., "Noark."

FUSE WIRE AND LINKS

Chase-Shawmut Co., "Shawmut."
Chicago Fuse Wire & Mfg. Co.
General Electric Co.
Harvard Electric Co.
Pass & Seymour.
Pierson, Roeding & Co., "Aluminum."

MISCELLANEOUS FUSES

Bryant Electric Co.
Harvard Electric Co.
Marshall Electric Co.
Perkins Elec. Switch Mfg. Co.
Weber Elec. Co., H. D. Sears Gen'l Sales Agt.

TELEPHONE FUSES

Dean Electric Co.
D. & W. Fuse Co.
Kierulff, B. F. Jr. & Co. "Sterling."
Standard Elec. Wks., "Couch & Seeley."
Western Electric Co.

GOVERNORS

WATER-WHEEL GOVERNORS

Pierson, Roeding & Co. "Lombard."

JOURNAL OF ELECTRICITY

POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

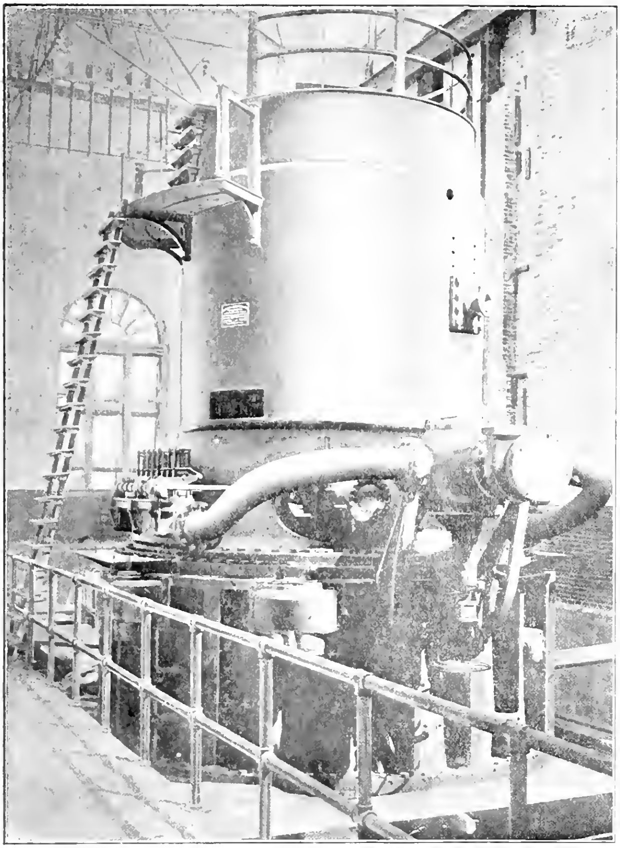
VOLUME XXII. SAN FRANCISCO, JANUARY 23, 1909 NUMBER 4

NEW STEAM PLANT OF THE UNITED RAILROADS OF SAN FRANCISCO

In order to keep pace with the rapid growth of San Francisco since the great fire, and the resultant demand for increased street car service, the United Railroads have found it necessary to make extensive additions to their entire electrical equipment. As the existing steam generating apparatus proved entirely inadequate, although supplemented by all the available power obtainable from both the City Electric Company and the Pacific Gas & Electric Company, a new source of power has recently been provided, in the form of a steam turbine generator set, installed during the past summer in the North Beach power house, and placed in service about November 1st last.

The North Beach power house was originally designed to contain four engine driven units, and some six years ago the first two of these were installed, each unit consisting of a triple expansion Union Iron Works engine to which were direct connected two General Electric revolving field generators, each generator rated at 1250 k. w., 25 cycles, 13,200 volts, a total of 5000 k. w. for the two units.

The new turbine, installed in the space originally provided for a third engine driven unit, is of the Curtis vertical shaft type, manufactured by the General Electric Company. The generator is rated 4 pole-5000 k. w.-750 r. p. m. 13,000 volts-25 cyles, has the usual overload capacity of 50% for two hours, and is designed for steam at 175 pounds gauge at the throttle and 28 inch vacuum. The turbine has standard exhaust base and separate Wheeler surface condenser, with 20,000 square feet cooling surface. Dry vacuum pumps are provided in duplicate, and are of Wheeler make, size 12" x 26" x 16". A 24-inch Wheeler centrifugal pump, operated by a 440 volt, 25 cycle, 200 h. p. induction motor at 500 r. p. m., furnishes cooling water for the condenser, and a 4-inch Wheeler two stage turbine pump, operated by a 30 h. p. induction motor takes care of the condensed steam from the hotwell. Two 30-gallon duplex Dean pumps, 14" x $3\frac{1}{2}$" x 12" supply oil at 900 lbs. pressure per square inch for the step bearing, and two "Durable" pumps, $5\frac{1}{2}$" x $3\frac{3}{4}$" x 5" supply oil at 120 lbs. pressure per square inch to the upper and middle guide bearings and to the hydraulic cylinder which actuates the steam valves. The return oil from step bearing, guide bearings and hydraulic cylinder is circulated through a No. 032 Turner oil filter, where it is cleaned and cooled before being used again.



5000 K. W. Curtis Steam Turbine Installed by United Railroads of San Francisco

A dead weight accumulator, with a plunger 16 inches

diameter and 12 feet stroke, having a total weight of 96 tons, is connected to the high pressure oil line to supply the step bearing with oil for about five minutes, should the pumps become temporarily inoperative.

The former capacity of the boiler room, which contained eight 500 h. p. Babcock and Wilcox boilers, has been increased by the addition of six 600 h. p. boilers of the same make, making a total of 7600 boiler horse power installed.

An additional turbine unit of 9000 k. w. capacity, with the necessary auxiliaries, will probably be installed in the same power house during the coming summer.

THE SIGNIFICANCE OF DRAFTS IN STEAM BOILER PRACTICE.

A preliminary bulletin on "The Significance of Drafts in Steam-Boiler Practice" is soon to be issued by the Technologic Branch of the United States Geological Survey. The authors of the bulletin, Walter T. Ray and Henry Kreisinger, in carrying out the particular work assigned to them in the general plan for the conservation of the fuel resources of the country have this to say in their bulletin:

"The experiments so far made seem to indicate that it is possible to double or treble the capacity of a plant without making any radical changes in the furnaces and boilers. These increases require about double and treble the quantities of air to be put through the fuel beds and boilers. It also seems probable that rebaffling the boilers will often permit the capacity to be doubled or trebled, while still getting more steam than formerly per pound of coal for uses outside the boiler room.

"These experiments were undertaken with the object of clarifying ideas concerning the passage of air through fuel beds and boilers. Measured weights of air were passed through two beds of lead shot, in series, one of which remained always the same and represented a boiler; the other being varied as to size of shot and depth of bed, and representing a fuel bed. Careful observations were made of the weight of air passing through the beds per minute. All data were plotted in many charts, so as to permit the study of them from several points of view. A number of laws were deduced bearing on the relative amounts of power required to force air through fuel beds of various thicknesses, composed of various sizes of coal, and through boilers of various lengths and areas of gas passages.

"An important part of the discussion relates to an increase in the capacity of boilers by increasing the amounts of power which must be applied to pressure and exhausting fans in order to force several times as much air through the fuel beds and boilers.

"It may be possible, as a result of these investigations, to raise the rate of working the boiler heating surface to three or even four times its present value. Such an increase would undoubtedly mean new designs of grates, stokers, furnaces and boilers, especially fitted for high rates of working. Fan equipments designed to supply three of four times as much air under several times the pressure would be provided with more efficient engines, which is an additional factor favoring high-capacity working.

"It must be borne in mind, as stated above, that the results are tentative. It will cost money to force gases at high speeds through fuel beds and boilers, and there will soon be pressing need of such quantitative data as will enable the largest possible part of the energy imparted by the fans to be advantageously utilized

"The attempt must not be made to put more air through existing boilers by running the fans a great deal faster, because the power consumed will increase far faster than the above calculations estimate. New fans and engines must usually be installed of sufficiently larger size to supply the larger quantities of air at as high an efficiency, if not higher.

"As has already been suggested, one way of reducing the work required from the fan in the case of doubling the capacity of the boiler is to increase the grate surface, so as to avoid a high increase of pressure drop through the fuel bed, increasing materially only the pressure drop through the boiler proper. A low pressure drop through the fuel bed would also insure better combustion of the fine particles of coal which would be carried out of the stack unburned if high gas velocities through the fuel bed were employed, the high velocities being obtained by high pressure drops. This last method is being successfully used by H. G. Stott and W. S. Findley, of the Interborough Rapid Transit Company, New York City. They have recently installed an extra Roney stoker under the rear end of each of several Babcock & Wilcox boilers, with the result that the amount of steam produced was nearly doubled, the combined efficiency of the boiler and furnace dropping only about 3 per cent. A complete description of the outfits and the results is given in a paper read by Walter S. Findley, Jr., before the American Institute of Electrical Engineers in December, 1907. In this case the pressure drop through the fuel bed was the same as with the single stoker, or perhaps decreased slightly. Of course, the pressure drop through the boiler proper increased considerably. An electrical engineer would say that the above experimenters put two fuel beds in parallel and with the same potential drop obtained twice the current (weight of gases). The same result could have been obtained by thickening somewhat the fuel bed on the single stoker and increasing the pressure drop through it, in which case the electrical engineer would say that the experimenters put two fuel beds in series and by increasing the drop of potential obtained twice the current (twice the weight of gases). The method of increasing the grate area is a promising one because it requires less work from the fans; it is especially to be preferred in those cases where there is a high pressure of slack in the coal, as already explained.

"The figures and principles derived from the experiments and tests presented in this bulletin may not be applicable directly to special problems; they suggest methods by which each problem can be studied and its successful solution brought about. Further experiments with laboratory apparatus as well as with hot fuel beds are desirable before more accurate figures can be given. The Geological Survey contemplates the making of such experiments in the near future, the results to be worked up and published in the next bulletin on 'Drafts.'"

Canadian use of Niagara's power was recently discussed by Hon. Adam Beck, minister of power in the Ontario cabinet. In addition to paying the actual cost of $9 or $9.40 a horsepower at the falls, municipalities will be required to pay operating expenses, besides 4 per cent of the actual cost of construction transmission lines, and a sinking fund sufficient to wipe out the cost of construction in thirty years, each muncipality being assessed its share. The rates to be charged by the city after purchasing power from the government commission are subject to regulation by the commission. The municipality can not sell for less than cost, and it is thus prevented from bonusing industries by offering free power, while a protest from any rate payer who believes the rate is too high will be sufficient to insure an arbitration by the commission. Work on the western extension of the transmission line can be carried on while the building of the line already contracted for is under way. The Ontario Power Company is planning to increase its output by 65,000 horsepower, at a cost of $800,000, in order to supply power to fourteen municipalities in the province of Ontario. Under the terms of its charter the Ontario Power Company may develop 180,000 horsepower. At the present time it is developing 75,000 horsepower. When the contemplated additions are completed the plant will be in position to deliver 140,000 horsepower. By the ruling of the War Department the Ontario Power Company may export to the United State 60,000 horsepower, while at the present time but 30,000 is being exported.

TRANSFORMER TESTING[1]

(Concluded from January 16)

Ratio and Polarity Tests.

Before a transformer is put into service it is well to make sure that the ratio and connections are correct. The ratio should be absolutely correct, otherwise the delivered voltage will be either too high or too low, causing short lamp life or low candle power. Correct ratios are always essential in multiple connection of transformers, otherwise cross currents will exist, causing undue heating, and eventually the burning out of some of the transformers.

To take the ratio test (see Fig. 6), see that the small switch P, controlling the lamp, is open; then close the secondary switch R, first to S then to S'. If the standard transformer is even then the two voltages read will be the same.

The correct polarity of a transformer is also another condition which must be taken into consideration when connecting two or more transformers in parallel. In speaking of transformers having the same polarity is meant that the instantaneous direction of currents in the leads joined must be the same.

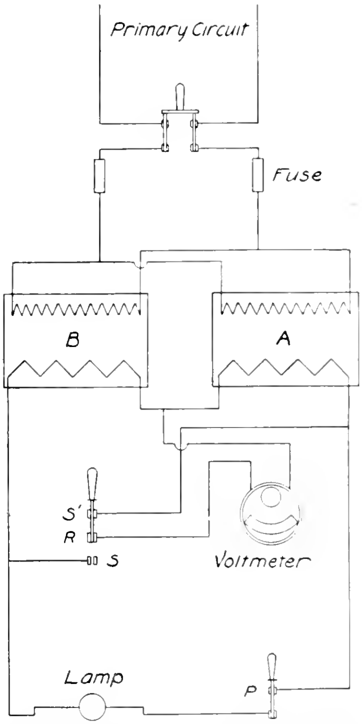


Fig. 6—Connections for Ratio and Polarity Test.

A transformer whose exact ratio and polarity are known should be available in making the following tests. Referring to Fig. 6, A is the transformer under test, and B a transformer of standard ratio and polarity. The secondaries of the two transformers are connected in series and to their common connection, one terminal of the voltmeter is connected, the other voltmeter terminal being connected to the central point of the single pole double throw switch. One or more incandescent lamps in series, whose combined voltage is equal to the total voltage of the two transformers are connected across the secondary leads of the transformers to determine the polarity.

To take the polarity test, see that the secondary switch R is open, and that the small switch P is closed, putting the lamps in circuit, then close main switch, and if the lamp or lamps light up, the polarities of the two transformers are the same.

If no standard transformer is to be had, another easy method of taking ratio and polarity tests is as follows:

Ratio can be determined by simultaneous readings of the primary and secondary voltage of transformer under test at no load. To read the primary voltage, a potential or standard transformer of 10 to 1 or 20 to 1 ratio must be used to step down the voltage to get within the range of a standard voltmeter. To get an accurate determination of ratio this test can be made only with carefully calibrated instruments.

Polarity—Referring to Fig. 7, the leads of the transformer are brought out so that when B and D are connected together a continuous winding is formed from A to C including all primary and secondary coils.

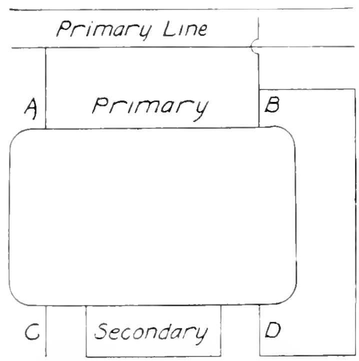


Fig. 7—Connections for Polarity Test.

Therefore, if a given voltage is impressed at AB, the voltage at AC will be greater than the impressed voltage if leads are brought out properly, and less than the impressed voltage if improperly brought out.

Another method of testing polarity where three-phase current is available is as follows: Assuming that the high voltage three-phase supply is available, the primaries of the three transformers will be connected up in delta on these three phases. The secondaries will be connected up in delta with a voltmeter, capable of withstanding twice the secondary voltage of one transformer, inserted in one of the connections across the voltmeter will be zero. If the polarity of any one of the three transformers differs from the other two, then the potential difference across the voltmeter terminals will be twice the voltage of one transformer. This connection is shown in Fig. 8.

If the low voltage three-phase current only is available then the secondaries should be connected in closed delta on the three-phase circuit, and the primary connected up in delta with one leg open circuited, and insert in this one circuit an auxiliary transformer to step down to suitable voltage for the voltmeter, as in the event of one transformer being of the wrong polarity the voltage will then be twice the primary voltage, and it is necessary to protect the voltmeter against a burnout, and this would be done by using a step down transformer of known ratio and connecting the voltmeter to the low voltage side of the auxilliary step down transformer.

[1] From "A Practical Guide for Transformer Testing" issued by Fort Wayne Electric Works.

Heat Test.

The temperature at which a transformer operates is the factor which limits the output, life and efficiency. High operating temperature causes deterioration of insulation, increased core loss due to aging of iron, and increased copper loss due to increased resistance of copper.

The A. I. E. E. recommends the temperature rise of transformers for continuous service shall not exceed 50° centigrade in electric circuits by resistance, all other parts by thermometer.

To obtain the temperature rise the transformer is operated with full load current of proper frequency until the temperature shall have become constant.

There are two general methods of obtaining full load current.

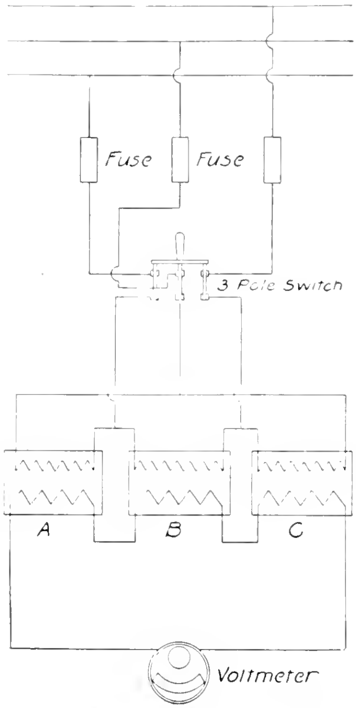


Fig. 8—Connections for Polarity Test.

First Method.

The transformer may be connected to a circuit of proper voltage and frequency and full load current obtained by loading the secondary with lamps or other resistance.

The energy in K. W. hours required for this method equals K. W. capacity of transformer multiplied by time of test in hours. As the energy required for a transformer of 3 to 5 K. W. capacity or over would be very large, this method is not used except with transformers of the smallest sizes.

Second Method.

This method is known as the "loading back" or "opposition" method. The advantage of this method is that no [illegible] except that to supply the copper and core losses is necessary. Therefore, this method may be used with transformers of large K. W. capacity with very little energy consumption.

Two transformers having the same voltage and ratio and as near the same K. W. capacity as possible are required for this test. The secondaries are connected in parallel (Fig. 9), and excited from a circuit of proper voltage and frequency, thereby inducing normal voltage in each primary. The two primaries are connected in series, but in opposition, thus making their combined voltage zero.

As each transformer is, in effect, short circuited by the other, it follows that approximately the sum of their impedance voltages applied across the primaries will impress full-load current in both primary and secondary windings.

This impressed voltage may be obtained from a small auxilliary transformer having a lamp bank or other suitable resistance in series with the secondary, by which the voltage may be adjusted until full load current flows in both windings.

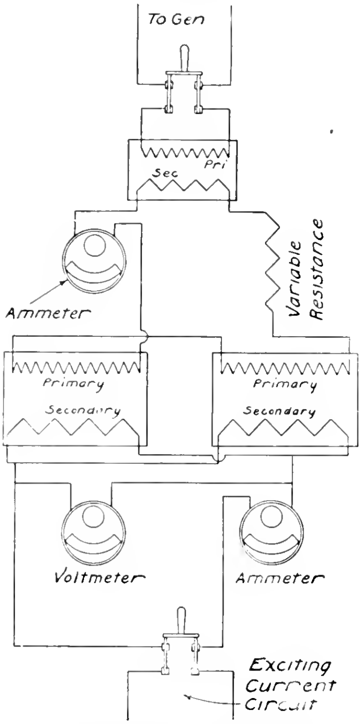


Fig. 9—Connections for Heat Test Loading Back or Opposition Method.

Before commencing this test the transformer should be filled with oil and left in room in which test is to be made long enough to attain same temperature as room.

Three accurate thermometers are necessary for this test. One to be suspended in room, one in oil in transformer case, and one with bulb secured to and in contact with outside of transformer case by putty, waste or string. Record temperatures as shown by thermometers and measure resistance of primary and secondary, same as under "copper loss"

Record thermometer readings every half hour and resistance of primary and secondary alternately every half hour.

Primary and secondary temperature rise must be figured from their respective readings.

The temperature rise of winding may be determined by the following formula:

$$\frac{\text{Res. Hot—Res. Cold}}{\text{Res. Cold}} \cdot 250 = \text{Temperature rise in degrees C.}$$

The core loss, exciting current, and copper loss

should be taken before and after the heat run. The core loss and exciting current should be less at the end of the run than at the start; if this is not the case, the transformer is either not well insulated or it is not thoroughly dried out.

If the core loss increases instead of decreases at the end of the run it would be well to measure the insulation resistance to determine the condition of the insulation.

The insulation resistance of a well insulated and thoroughly baked out transformer should not be less than one megohm from primary to secondary or from primary or secondary to ground.

Fig. 10 shows the method of taking insulation resistance The supply voltage may be any voltage from 110 to 550 volts direct current, and voltmeter should have sufficient range to measure supply voltage.

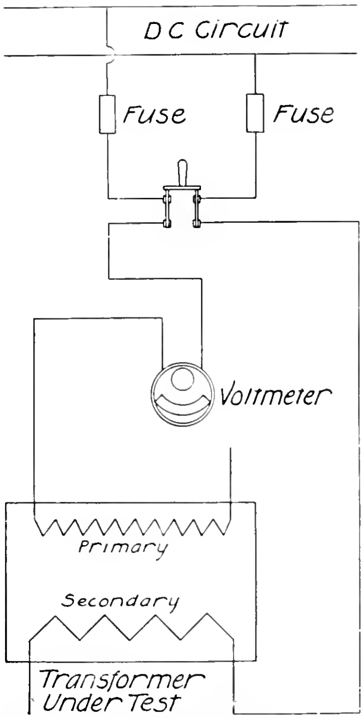


Fig. 10—Connections for Insulation Resistance Test.

Insulation resistance=Total line voltage less the voltmeter reading between winding and ground, or between primary and secondary multiplied by the resistance of the voltmeter and this result divided by the voltmeter reading between winding and ground or between primary and secondary, will give the insulation resistance in ohms.

The copper loss will be greater due to the increased resistance at the high temperature.

Regulation.

The regulation of a transformer is the percent increase of the secondary terminal voltage as the load is decreased from full load to no load.

This test should be made by observing the voltage at the secondary terminals of the transformer, at full load and no load, the primary voltage and frequency being held constant at all times.

The regulation expressed in percent will be the difference between the full load and no load readings, divided by the rated secondary full load voltage of the transformer.

This method of taking test is not satisfactory, due to the very small increase in secondary voltage from full load to no load, and in most cases a central station has no means of loadng the larger sizes of transformers.

The regulation of a transformer may be obtained accurately and reliably by calculation, as given in the following method:

Non-inductive Load: Total IR=Resistance drop of primary and secondary expressed in percent of rated voltage.

$$\text{Impedance percent} = \frac{\text{Rated voltage of transformer}}{\text{Impedance Volts}}$$

Reactive drop= { The square root of the difference of the squares of the impedance percent and total IR percent.

$$\text{Exciting current } \% = \frac{\text{Exciting current (amps.)}}{\text{Rated full load (amps.)}}$$

Magnetizing Current %=75% of Ex. Current in percent.

Then the regulation of a transformer for non-inductive load may be expressed thus:

100+Total IR percent + (% Mag. Cur. x % React. Drop) + Quadrature drop (See table).

Inductive Load

With a power factor of 80 percent, the wattless factor of the load becomes 60 per cent, and to this is added the percent magnetizing current (which in most cases might be neglected on inductive load.)

The quadrature drop in this case=(80 percent x Reactive drop percent.)—[Wattless factor (which is 60% plus magnetizing current percent), x total I R percent)] which is taken from table and in most cases may be neglected.

Hence the regulation for inductive load, 80 percent power becomes

100 + (Total I R percent x 80 percent + [Reactive drop x (60 percent + the magnetizing current percent)] +Quadrature drop percent.

Quadrature Drop	Increase in Second Voltage	Quadrature Drop	Increase in Second Voltage
Per Cent.	Per Cent.	Per Cent.	Per Cent.
2.5	.025	6.5	.21
3.0	.04	7.0	.24
3.5	.06	7.5	.27
4.0	.08	8.0	.31
4.5	.10	8.5	.35
5.0	.13	9.0	.39
5.5	.15	9.5	.45
6.0	.18	10.0	.50

Efficiency.

The efficiency of a transformer is the ratio of its net power output to its gross input, the current being measured with non-inductive load. The power input includes the output plus the core loss and the I^2R loss of both primary and secondary windings at a given load on the transformer.

The copper loss by wattmeter may be used instead of the I^2R loss in calculating the efficiency.

The total losses of a transformer are made up of a constant loss or the core loss, and a loss varying as the square of the current, or the copper loss.

For example, we will take a 5 K. W., 60 cycle, 1100/2200 volts primary, 110/220 volts secondary Type A Oil Transformer.

Primary—2200 volt connection..........= 2.27 amp.
Secondary—22 volt connection..........= 22.7 amp.
Resistance of primary ....= 8. ohms
Resistance of secondary .... .09 ohms

Losses—Full Load.

Primary I^2R	41.3	watts
Secondary I^2R	46.4	"
Total I^2R	87.7	"
Core loss which is constant	48.	"
Total loss	135.7	"
Output at full load	5000.	"
Input at full load	5135.7	"

Efficiency .... $100\% - \frac{135.7}{5135.7} = 97.35\%$

Losses—Half Load.

Total I^2R = ($\frac{1}{4}$ of full load I^2R) =	21.9	watts
Core loss	48.	"
Total loss	69.9	"
Output	2500.	"
Input	2569.9	"

Efficiency .... $= 100\% - \frac{69.9}{2569.9} = 97.35\%$

All Day Efficiency.

The all day efficiency of a transformer is the ratio of the output to the input during 24 hours. Taking the same transformer as above, with

Full load for two hours
Half load for two hours
Quarter load for two hours.
One-tenth load for eighteen hours.

the all day efficiency would be as follows:

Load	Watt-hours	I^2R Loss
Full	10,000	174.5
$\frac{1}{2}$	5,000	43.8
$\frac{1}{4}$	2,500	11.
1-10	9,000	15.8
	26,500	245.1

Core loss for 24 hours, 48 x 24=1,152 watts.

Total losses for 24 hours=1,152 watts plus 245=1,397 watts.

Total output for 24 hours=26,500 watts.

Total input for 24 hours=27,897 watts.

All day efficiency $= 100\% - \frac{1,397}{27,897} = 95\%$

Oil for Transformers.

The oil used in transformers performs two important functions: It serves to insulate the various coils from each other and from the core, and it conducts the heat from the coils core to some cooler surface, namely, the transformer case, where it is dissipated in the surrounding air.

It is evident that the oil should be free from any conducting material. It should be sufficiently thin to circulate rapidly when subjected to difference of temperatures at different places, and it should not be ignitable until its temperature is raised to a very high value.

A good grade of transformer oil should show very little evaporation at 100°C, and it should not give off gases at such a rate as to produce an explosive mixture with the surrounding air at a temperature below 180°C. It should not contain moisture, acid, alkali or sulphur compounds.

It has been shown that the deteriorating effect of moisture on the insulating qualities of an oil is very marked; moisture to the extent of .06 percent reduces the dielectric strength of the oil to about 50 percent of the value when it is free from moisture, but there is very little further decrease in the dielectric strength with an increase in the [illegible] of moisture. Dry oil will withstand a break-down [illegible] between two .5 inch knobs separated by [illegible]. The presence of moisture can be detected by [illegible] in the oil; if the oil "crackles" water is present.

THE MANUFACTURE OF INCANDESCENT LAMPS.[1]

By F. S. Mills.

In an incandescent lamp the essential parts are the bulb, stem, filament, joint, platinum leading-in wires, copper-leading-in wires, and base. When the incandescent lamp was first manufactured the filament was made from metals, thread and bamboo. Metals proved too expensive and the temperature at which they softened and became weak was too low. The thread was the most successful, although the artificial filament now in use is far better than any other used.

A thread filament must be strong enough to withstand the mechanical handling and shipping, must be a partial conductor and must offer resistance to the passage of current; in order that it may glow and emit light it must be sufficiently durable to withstand incandescence and not disinteregrate too rapidly. These requirements are met by combining vegetable matter with an acid, the usual method being to dissolve absorbent cotton in a solution of chloride of zinc. This combination of absorbent cotton and chloride of zinc solution is put in a compartment so as to maintain a constant temperature and while in this state has the appearance of dark molasses. It is then poured into stout glass bottles and squirted through a die by means of air pressure which forces it out as a white sticky thread. During this operation the die is immersed in alcohol contained in a jar mounted on a slowly revolvng base so that the thread does not come in contact with the atmosphere. The alcohol hardens and bleaches the thread.

The shrinkage during the manufacture of filaments is considerable. The diameter of the filament upon leaving the die is 22/1000 of an inch but it soon shrinks to 5/1000 of an inch. The filament after leaving the jar and being dried, is wound on large drums where it is roughly sorted according to size and shape, such as an oval coil, double coil, spiral or hairpin, as the case may be. While wound on these forming drums it is placed in an oven and heated to a moderate temperature. In order to set the filament in shape after this process the filament is cut off the forms and packed in boxes surrounded by carbonaceous material. The box or crucibles are placed in furnaces air-tight, having burners in the center. This is heated to a preliminary heat at a low temperature and to a final heat at a high temperature, lasting for some hours. This process changes the delicate white thread to a hard, stiff, and brittle carbon. The peculiarity in which carbon differs from other material when used as a conductor is that it is negative, and as it increases in heat the resistance decreases. In other words a carbon filament has one-half the resistance when hot as when cold. In metal conductors the resistance increases as the temperature increases, it being positive.

The glass used in a lamp will stand a high temperature without changing its quality. It must be very clear so that no light may be lost in transmission through it, and capable of being worked into different shapes.

The bulb or glass furnished by the glass factory has no tip on the end but has a neck below the shoulder about three inches long. The bulb is cleaned thoroughly before using and then tubulated, that is a small glass tube is affixed to the end of the bulb which in turn is used to connect a pump to exhaust the air. After exhausting, this tube is cut off and what is known as the tip of the lamp left. The next step is to mount the filament on the finished stem, paste being used to join the filament to the platinum leading in wires in the stem. Sealing is accomplished by heat, which operation is performed by melting down the neck of the bulb over the flare of the stem, making a complete glass envelope.

[1] Extract from paper read at Sales Conference of the San Francisco office of H. W. Johns-Manville Company.

The lamp is exhausted by placing a compound in the small tube which has heretofore been attached to the bulb and then heating. The gases of the chemical unite with the gases given off by the filament and joints of the lamp, forming an inert gas which is rapidly drawn out by a mechanical pump. After the lamp is taken off the pump, the next step is to decide at what voltage the lamp will give 16 c. p., at $3\frac{1}{2}$ watts, providing they are manufacturing this type of lamp. About 80% of the results will run from 108 to 112 volts, the remainder running outside, some being as low as 104 volts, and as high as 116 volts. You can then see what advantage the large manufacturer has over the small one, as he is able to stand that loss in the manufacture.

To test the candle power of a lamp in terms of a unit is the next step, the British Parliamentary standard candle being used. For instance if a pencil be held upright on a piece of white paper and a 16 c. p. lamp be held at a given distance, the pencil will throw a shadow of a certain density. If an 8 c. p. lamp were placed at the same distance the density would be much less, this roughly is the photometric principle of testing a lamp for candle power.

A standard lamp is decided upon and placed at a given point, then a lamp to be tested is placed at an opposite position on the scale so as to throw a shadow opposing a standard lamp. When the shades are equalized a reading is made on the voltmeter and the voltage of the lamp decided upon.

The test lamp used is checked frequently with twenty to thirty other standard lamps and if found to be off is replaced by another standard lamp. The definition of the British Parliamentary standard candle is a candle 8-10 inch in diameter at the top and 9-10 inch at the base, weighing 1,200 grams avoirdupois, which is about 6 to the pound, and burning at the rate of 120 grams per hour. The German standard candle is about 88% of the English unit, in other words a 16 c. p. lamp made in Germany would be about 14.1 c. p. of our standard.

The range of candle power now guaranteed for a 16 c. p. lamp is from 14.8 to 17.2 c. p. The effects of voltage on the candle power of a lamp is as follows: In the 100 to 125 volt class one volt equals one candle power, in the 50 volt range, one volt equals two candle power, and in the 200 to 250 volt range, one volt equals one-half of one candle power. You can see how the exact voltage and assortment of lamps results in good work for the factory. If the factory is to supply 110 volt lamps they must discard everything below 108.8 and above 111.2 volts, as they are allowed only a variation of 1.2 from the required voltage.

The finishing operations in the manufacturing of a lamp are the sorting, basing, washing and drying, labeling, wrapping and packing. The sorting is more of an inspection after the lamps leave the testing room. Basing is divided into two operations. The first consists in placing suitable cement on the inside of the base, fitting the base to the neck of the lamp, threading the wires and heating the base in order to dry the cement which firmly grips the neck of the lamp. The lead-in wires are then cut off and soldered to the two conducting parts of the base.

In the Edison base which is used now, almost exclusively, one wire is soldered to the small brass cap at the lower end of the base and the other to the outer shell at the top.

The packing of the lamp is the most important part, as the tip of the lamp must be protected. Formerly lamps were packed in barrels in small cartoons but the manufacturers are now placing them in rectangular boxes with cardboard crates to separate the lamps.

In order for a lamp to be perfect the vacuum must be good. A fair test for this is to strike the lamp against the palm of your hand and note the vibration of the filament. At a high vacuum it is almost impossible to hold the lamp so the filament will not vibrate.

The life of an ordinary lamp is expressed in two ways. One is to define it, as the length of time a lamp burns from the time it is started until the filament breaks and the lamp expires or ceases to burn. The effective life has been generally assumed to be the number of hours of burning from the start until the lamp has dropped to 80% of its initial c. p.

The greater the watts per candle power the longer the life of the lamp, that is a 3.5 watt lamp will live nearly twice as long as a 3.1 watt lamp. The drop of candle power of a lamp is caused by two things, one being a disintegration of the filament and the other the gathering of black particles of carbon on the glass coming from the carbonized filaments thus opposing the candles thrown.

A rough rule showing the effect of voltage on the life of a lamp is that a 4% increase of voltage will reduce the lamp one-half the life, and a 4% decrease in voltage will double the life of the lamp. From this rule you can see what effect a badly regulated circuit would have upon the life of a lamp. The following is the approximate life of a carbon lamp:

16 c. p.	3.1 watt	500 hours
16 c. p.	3.5 watt	900 hours
16 c. p.	4. watt	2000 hours

The Linolite lamp and reflector is the result of an endeavor to improve the distribution of light from the standard carbon filament lamp. The illuminant itself consists of a carbon filament placed lengthwise in a glass tube. It is straight, except for a loop in the center which permits the contraction and expansion of the filament or tube. The filament is the same in size and length as used in a 16 c. p., 3.5 watt lamp, resulting in the same consumption of current, the reflector being $2\frac{1}{4}$ inch in width, easily hidden in a show window or show case where most any other reflector would be large and bulky. The reflector is made of aluminum, polished on the inside and satin finish on the outside, or can be satin finish on both sides. This type of illumination can be used to great advantage for picture, sign, desk lamp, or other special lighting effects as desired, having good results when used for indirect lighting systems.

The Linolite lamp is manufactured along the lines of the O'Brien lamp which was not successful, however, owing to the fact that the filament was not anchored except at each end of the tube. Nor did they allow for the contraction or expansion, and consequently the filament sagged within a short time and burned out quickly.

In reference to the life of the Linolite lamp, I refer to a test made in a store in San Francisco which installed a four foot section in a show case. The life of the first lamp was 555 hours, the second 650 hours, third and fourth lamps were still burning at the end of 650 hours. The test made by the lighting company on the voltage in this store resulted in the voltage reading 121 volts at 2 p. m. and 116 at 6:30 p. m., while the Linolite lamps were for use on a 110 volt circuit. As stated a 4% increase of voltage on the circuit will reduce the life of the lamp 50%. This will prove the life of the Linolite lamp to be greater than 1000 hours according to the above test on life, at the named voltage variation.

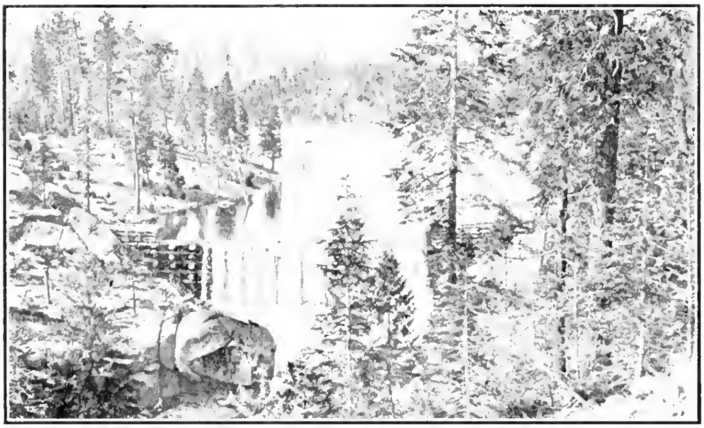
All the light in the Linolite system is utilized to illuminate the goods displayed, no light is wasted outside the window and the intensity of illumination becomes so much greater than the general illumination surrounding the window. This is apparent by aking a section of Linolite and holding it in such a position so as to define a shade line across the hand, then withdraw the hand and note how far away from the illuminent the shadow is still visible.

The tungsten lamp is rated, however, in watts consumption and not in candle power. The rate of consumption per candle power is approximately $1\frac{1}{4}$ watts. Manufacturers of lamps in the United States have been unable to develop a 220 volt tungsten lamp owing to the condition of the filament in its low resistance and weakness.

HIGH TIMBER DAMS IN CALIFORNIA.[1]

E. M. Chandler.

There are within the Sierra Nevada Mountains many monuments to the skill and fortitude of that hardy class of men known as the old California miners. Not the least interesting and daring of these are some of the comparatively high log dams constructed on the mountain streams for the diverting and the storing of water, for use during the long, annual low-flow season, which have been used in furthering the interests of placer mining in the early days, and later for power and milling purposes during the advent of the quartz miners. There are several of these dams upon the South Fork of the Stanislaus River, which are now the property of the Tuolumne Water Power Company, and were formerly owned by the Tuolumne County Water Company, which began to furnish water to the miners in the early 50's.

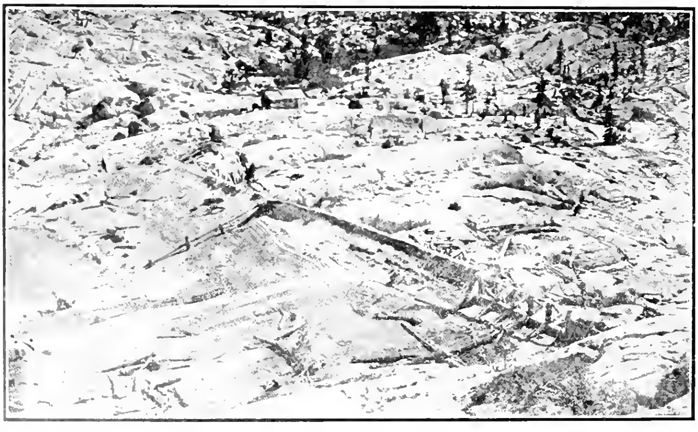


Lyons Dam on South Fork of Stanislaus River.

The largest of these dams, locally known as Big Dam, is located in a very rugged granite canyon, at an elevation of about 7,300 feet, and when first constructed in 1856 had a maximum height of 62 feet and a length approximately 450 feet. The catchment area above amounts to only 18 square miles, and the estimated capacity of the reservoir is said to have been about 4,000 acre-feet. About twenty years afterward, when, on account of the decline of placer mining, the demands upon the stored waters were not so great, and on account of the rotting of portions of the timber exposed to the air, the height was cut down to a maximum of about 44 feet, which is as shown in the accompanying photograph. The length of the present dam is 385 feet, and the capacity of the reservoir thus formed [illegible] about 2,000 acre-feet. The [illegible] of construction used is [illegible] general class which will be described subsequently. [illegible] dam of interest, called Lyons Dam, is located on this same stream at a short distance above the point of diversion of the main ditch of the Tuolumne Water Power Company. This dam was constructed in 1897 under the direction of Mr. C. E. Grunsky, being built at a cost of about $20,000, having a maximum height of 55 feet and an extreme length along the crest of about 210 feet. The down-stream slope is nearly vertical, and the up-stream side has a slope of 2½ to 1 feet. There are two lengths of cedar logs laid, as shown on the accompanying sketch, with the butt ends pointing downstream. The joint between the ends of the top layer of logs at the up-stream end, and the solid granite foundation, has been made with the aid of concrete.

The larger logs were laid in layers 8 feet apart, while the smaller ones have an interval of only 4 feet, and the "risers," or the logs lying parallel to the axis of the structure, have an interval varying from 4 to 8 feet. The function of this log crib-work is, of course, to support an almost waterproof timber apron, consisting of two 4-inch layers of planking covering the entire up-stream slope, which is embedded in concrete at its intersection with the foundation.

The leakage through this apron has been inconsiderable, but it is considered an advantage to have a small amount of water trickling through the log crib-work to delay or prevent rotting. This structure has been erected contrary to two general rules relating to the design of timber dams, namely, (1) to have a flat slope or stepped cross-section on the down-stream side unless the height is insignificant, and (2) to have the entire interior timbers sealed from the access of air, since it is believed that the odors which would arse from the damp timbers tend to promote decay. Observations made by the writer seem to indicate that, although the fall and volume of the waste water are considerable, no serious wearing away of the granite at the lower toe of the structure has occurred, and although it is true that the logs are open very largely to the air, the examples of other dams built

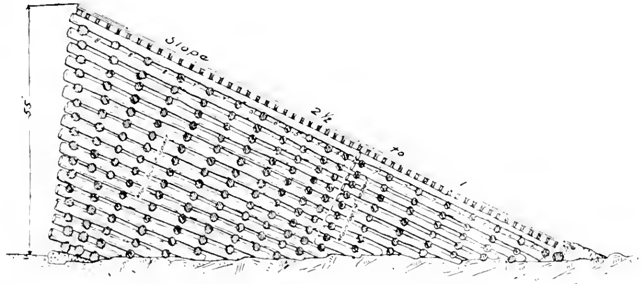


Big Dam on South Fork of Stanislaus River.

[1] [illegible] California Journal of Technology, to whom we also are indebted for the illustrations.

along the same lines and under the same climatic conditions have shown a remarkable life for timber structures.

The flood waters of the stream are passed over the crest by means of a spillway 131.5 feet long, thus taking up the greater length parallel to the axis. The remainder of the crest consists of two rock-filled cribs, one at either end, to give mass to the structure and to take up the shocks which might arise from floating trees and ice during times of flood. It is apparent from the accompanying photograph that the spillway is not level, but this is due to a settling near the left bank shortly after construction, which has caused no serious trouble. The dam successfully withstood the flood of March, 1907, in which it is estimated that about 4,500 second-feet passed over the crest, representing the run-off from a draining basin of 70 square miles equivalent to a water yield of 64.3 second-feet per square mile of catchment area.



Sketch of Maximum Section of Lyons Dam

PRESIDENT VETOES DAM BILL.

President Roosevelt sent to the House on January 15 a message vetoing a bill for the construction of a dam across James River, Missouri, by William H. Standish, declaring the measure did not contain the conditions essential to protect the public interest. The President referred to the control of water power sites and said that more than 33 per cent of the total water power now in use probably was controlled by thirteen concerns.

Following is the message in part:

"The House of Representatives: I return herewith without my approval house bill 17707 to authorize William H. Standish to construct a dam across James River, in Stone County, Missouri, and divert a portion of its waters through a tunnel into the said river again to create electric power. My reasons for not signing the bill are:

"The bill gives to the grantee a valuable privilege which by its very nature is monopolistic and does not contain the conditions essential to protect the public interest."

President Roosevelt quotes from a letter he wrote on March 13, 1908, to the Senate Committee on Commerce in pursuance of a policy declared in his message of February 26, 1908. In this letter the President says:

"Through lack of foresight we have formed the habit of granting without compensation extremely valuable rights, amounting to monopolies, on navigable streams and on the public domain.

"The repurchase at great expense of water rights, thus carelessly given away without return, has already begun in the East, and before long will be necessary in the West also.

"No rights involving water power should be granted to any corporation in perpetuation, but only for a length of time sufficient to allow them to conduct their business profitably.

"A reasonable charge should, of course, be made for valuable rights and privileges which they obtain from the National Government. The values for which this charge is made will ultimately, through the natural growth and orderly development of our population and industries, reach enormous amounts.

"A fair share of the increase should be safeguarded for the benefit of the people from whose labor it springs. The proceeds thus secured, after the cost of administration and improvement has been met, should naturally be devoted to the development of our interest and waterways.

"Accordingly I have decided to sign no bills hereafter which do not provide specifically for the right to fix and make a charge and for a definite limitation in time of the right conferred."

An amendment to the present bill expressly authorizing the government to fix a limitation of time and impose a charge was proposed by the War Department, but turned down by the Senate Committee on Commerce on the ground that it was "a new departure" and not authorized by the power of the Federal government. After arguing in behalf of the legality of such limitations the President continues:

"Believing that the National government has this power I am convinced that its power ought to be exercised.

"The people of the country are threatened by a monopoly far more powerful, because in far closer touch with the domestic and industrial life than anything known to our experience.

"A single generation will see the exhaustion of our natural resources of oil and gas and such a rise in the price of coal as will make the price of electricity transmitted water power a controlling factor in transportation, in manufacturing and in household lighting and heating."

Information collected by the Bureau of Corporations, says the President, shows that certain large concerns, of which the General Electric Company and the Westinghouse Electric and Manufacturing Company are now the most important, now hold water power installations and advantageous power sites aggregating almost 1,046,000 horsepower, of which the control by these concerns is practically admitted. This is a quantity equal to over 19 per cent of the total now in use.

Further evidence, he says, makes it probable that thirteen concerns directly or indirectly control valuable water power and advantageous power sites equal to more than 33 per cent of the total water power now in use.

"The great corporations are acting with foresight and singleness of purpose and vigor to control the water powers of the country. They pay no attention to state boundaries and are not interested in constitutional law affecting navigable streams except as it affords what has been aptly called a 'twilight zone,' of which they may find a complete refuge from any regulation whatever by the public whether through the National or the State governments.

"They are demanding legislation for unconditional grants in perpetuity of land for reservoirs, conduits, power houses and transmission lines to replace the existing statutes which authorizes the administrative officers of the government to impose conditions to protect the public when any permit is issued.

"Several bills for that purpose are now pending in both houses. These bills were either drafted by representatives of the power companies or are similar in effect to those thus drafted."

He now suggests another condition, namely, that the license should be forfeited upon proof that the licenses has joined in any conspiracy or unlawful combination in restraint of trade, as is provided for grants of coal lands in Alaska.

"I will sign no bill granting a privilege of this character which does not contain the substance of these conditions. I consider myself bound, as far as exercise of my executive power will allow, to do for the people in prevention of monopoly of their resources if they were in a position to act. Accordingly, I shall insist upon the conditions mentioned above, not only in acts which I sign, but so in passing upon plans for use of water power presented to the executive departments for action.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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CONTENTS

Our issue of January 30, 1909, will contain a paper, "How Far Can We Go With Automatic Regulation on Our Electric System," read by Mr. J. S. Lighthipe, engineer for the Edison Electric Company, before the Los Angeles Section of the American Institute of Electrical Engineers, together with discussion thereon. Arrangements have been made whereby the papers read before the Los Angeles, Seattle and San Francisco Sections of the Institute will be published in our columns. These papers are not printed in the Transactions of the Institute, and deal largely with purely Western conditions.

Water Havoc

Although the power of water has been harnessed and its course confined, it occasionally breaks its bounds and like a maddened team of runaway horses, demolishes everything in its path. Last week the Pacific Coast was visited by a great storm, rain in the valleys and snow in the mountains. As the barometer went down the thermometer went up and the snow melted rapidly. The run-off became enormous—every little mountain rivulet became a raging torrent, each pouring its debris-laden burden into the cramped channels of the larger streams and thence to the great river valleys where relief was not found until the artificial barriers had been broken down and the land flooded.

Now the storm has abated, the waters are subsiding and we are reckoning the damage done. Fortunately, the loss of life was slight.

In the mountains the electric power companies were the heaviest losers. Reno, Nevada, is in darkness, and the mines at Virginia City, as well as the railroad shops at Sparks, are without power because high water and land-slides have disabled the several power plants recently acquired by F. G. BAUM and associates. The newly started generator of the Great Western Power Company on the Feather River above Oroville, California, was stopped because the oil tanks were emptied by the rising waters and the tracks of the Western Pacific railroad were washed away, so that the supply could not be renewed. Many of the flumes of the Stanislaus Electric Power Company, near Angels Camp, were carried away and the Philbrook valley dam of the Oro Water, Light and Power Company went out, causing a loss of fifty thousand dollars. The flood also carried with it the small dam of the Diamond Match Company and that of the Valley Counties Power Company, a subsidiary of the California Gas and Electric Corporation. The latter suffered but little loss, although some inconvenience was caused by short-circuiting and many of their pole lines are in the flooded valley districts.

It was in the valleys that the greatest damage was done. Railroad bridges and embankments were washed out and tracks flooded. As the wires were also down, communication had to be diverted and all service delayed. It is of interest to note that the bridge of the Northern Electric road has been connected with the main line of the Southern Pacific and will be used for all through trains until the other bridges can be rebuilt. Ranches and towns have been submerged, and a great acreage of reclaimed land devastated. One gold dredger was wrecked and several temporarily incapacitated. It is as yet too soon to estimate the total amount of damage.

It is possible that this disaster will bring about concerted and systematic action for the building of levees to keep the flood waters from the furtile valley lands. Hitherto these have been built without regard to their possible effect on existing barriers and

unless some relief is provided by law it will be impossible to protect many rich sections. For power companies the flood has set a new high watermark and gives warning of the tremendous power of which hydraulic energy is capable when it sweeps aside the puny trammellings of man.

THE NATIONAL CONSERVATION COMMISSION.

The National Conservation Commission, established by President Roosevelt, contains four sections, namely, Waters, Forests, Minerals and Lands, the duties of the Inland Waterways Commission having been merged in the first-mentioned. Mr. Gifford Pinchot, Forester, is chairman of the Commission and Mr. T. R. Shipp secretary. The first work has been to inventory the resources of the country, a stupendous compilation of statistics. This report is to be transmitted by the President to Congress.

It contains some startling statements as to waste of our fuel resources. It is said that there is enough gas to light all the cities in the United States of over one hundred thousand population needlessly escaping from gas and oil wells. The report demonstrates that the existing and known coal fields of the country contain only enough unmined coal to last until the middle of the next century.

The Section of Minerals recommend certain changes in the laws governing the handling of oil wells and oil lands, and they affirm that the use of oil as fuel for locomotives and other engines is an unnecessary waste of this resource.

The fuels, supplying heat, light and power for domestic and industrial purposes, are the most fundamentally essential resources of the Nation. Use of fuels involves their immediate and complete destruction. The use of large quantities of other materials also increases the rate of consumption of the fuels; for, as the Nation has now passed the stage of early development, the use of fuels is increasing much more rapidly, in proportion to increase of population, than in the past. The mining industry of the country furnishes our light, heat and power, and supplies sixty-five per cent of the freight traffic of the country. The annual waste in mining and treating mineral products is more than $300,000,000.

This report will have a large influence on future legislation, particularly with regard to inland waterways and hydraulic power restrictions.

REMOVAL NOTICE.

The Benicia Iron Works have moved their San Francisco office from 848 Monadnock Building to 559 Monadnock Building.

On and after Monday, January 25th, the executive and sales offices of the Pelton Water Wheel Company will be removed to Suite 1099 Monadnock Building, City, where all future communications should be addressed. The drafting room, offices of the Secretary, Mr. David Donzel, and the Purchasing Agent, will remain in the shop, Nineteenth and Harrison streets, San Francisco.

MEETING NOTICE.

American Institute of Electrical Engineers, Los Angeles Section, met at Pacific Electric Grill, Tuesday, January 19, 1909, 6:30 p. m. for an informal dinner and smoker, followed by an interesting entertainment.

The regular meeting of the San Francisco Section of the American Institute of Electrical Engineers was held in the basement of the building occupied by the Pacific Gas and Electric Company, 925 Franklin street, Friday, January 22, 1909, at 8 p. m. Mr. E. L. Sherwood read a paper entitled, "Lighting with Metallic Filament Lamps."

PERSONALS.

F. E. Vickers, engineer with the San Francisco office of the General Electric Co., is making a short trip to Los Angeles.

George R. Murphy, engineer with the San Francisco office of the Electric Storage Battery Company, is in Los Angeles.

A. W. Ballard, manager of the Los Angeles office of the General Electric Co., has been in San Francisco during the past week.

W. J. Davis, Jr., electrical engineer with the San Francisco office of the General Electric Co., has returned from a trip to Schenectady.

F. C. Vaughen, Sales Manager of the Meter Department of the General Electric Company, with headquarters at Schenectady, accompanied by Mrs. Vaughen, has returned East after a pleasant two weeks' outing on the Coast.

P. H. Coolidge, manager of the Pacific Coast interests of the Western Electric Company, left for Chicago and New York on January 20th and while in the East will attend the annual conference of the managers of the various houses of that Company.

E. S. Utley, who has been in charge of the Incandescent Lamp Department of the Western Electric Company, San Francisco, for several years, will leave for New York on February 1st, where he will fill a similar position in the New York office of his company.

Garnett Young, manager of the Telephone and Electric Equipment Company on the Coast, has returned from a trip of several months through the East, during which time he was in conference with all of the manufacturers whose interests they have charge of in this section.

T. E. Burger, with Mrs. Burger, left San Francisco for the East on January 20th, where he will attend the annual conference of managers of the Western Electric Company to be held at Chicago. Mr. Burger occupies the position of Assistant Manager of the Los Angeles house of that company.

P. J. Aaron, manager of the Seattle house of the Western Electric Company, attended the meeting of the Electrical Jobbers' Association at Del Monte and left there to join Mrs. Aaron, who was awaiting him in Los Angeles. They left for the East immediately, where Mr. Aaron will attend the managers' conference of his company.

S. N. McFedries, secretary and treasurer of the J. L. Schureman Company of Chicago, left San Francisco for the Northwest on January 19th. Mr. McFedries, in addition to the business position he occupies, is secretary of the Chicago Electrical Club and was present at the meeting of the San Francisco Electrical Club on January 16th, during which he was called upon for some remarks and gave the local electrical people a talk which included some good advice and profitable information.

TRADE CATALOGUE.

Bulletin No. 1 from the Kelman Eliectric and Manufacturing Co., of Los Angeles, California, illustrates and describes the Kelman High Voltage Oil Switches and Oil Circuit Breakers.

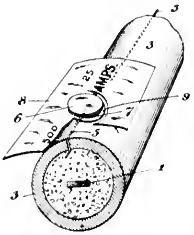
No. 2 of Motor Talks from the Westinghouse Electric and Mfg. Co., is about Display Window Advertising. It is so well written that any possible user or seller of electric power will read it all.

New Departure Manufacturing Co., Bristol, Conn., sent a handsome catalogue illustrating and describing their Two-in-One Ball Bearings that is claimed to be equally efficient in all directions and are particularly adaptable for automobiles.

The Standard Engineering Co., 60 Natoma street, San Francisco, Cal., announce that they are thoroughly equipped for, and will make a specialty of high-class power plant design and construction. R. J. Davis is president, A. St. J. Bowie, vice-president and C. F. Braun, manager.

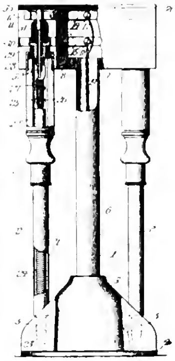
PATENTS

908,646. Indicating Fuse. Robert C. Cole, Hartford, Conn., assignor to The Johns-Pratt Company, Hartford, Conn., a Corporation of Connecticut. Filed Jan. 3, 1907. Serial No. 350,-622. 1. An indicating means for inclosed fuses, comprising a dischargeable screen normally overlying and obscuring



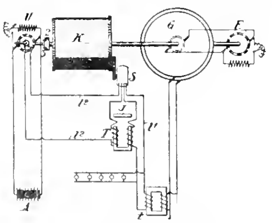
a portion of the fuse inclosure, in combination with an indicator-wire having sufficient gas-producing capcity, upon its electrical disruption, to discharge said screen, and being located upon the fuse inclosure in a position to effect such discharge thereby.

908,712. Electrical Heating Apparatus. Emmet L. Van Dolsen, Berwyn, Ill., assignor to Western Electric Company,



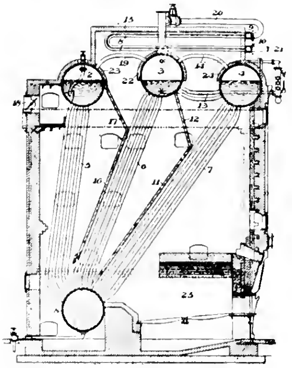
Chicago, Ill., a corporation of Illinois. Filed Feb. 23, 1906. Serial No. 302,494. 5. A supporting device for electric soldering irons comprising a metallic base, having a plurality of pockets therein, a hollow standard rising from said base, an insulating head carried on the top of said standard, and a plurality of sets of contact terminals mounted on said insulating head.

908,474. Method and Device for Electrically Regulating the Speed of Prime Movers, Especially Turbines. Friederich Von Merkl, Vienna, Austria-Hungary. Filed Jan. 31, 1908. Serial



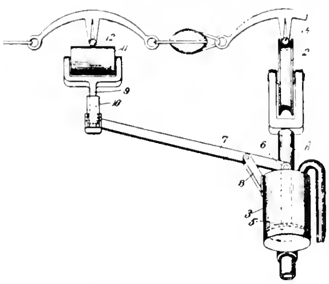
No. 413,680. 1. The combination with a rotating body, the speed of which is to be governed of means for generating an alternating current fixed in phase with relation to said rotating body, a rotating generator for supplying an alternating current variable in phase with relation to said rotating body, speed regulating mechanism for said rotating body, a motor operative by out of phase currents for controlling said regulating mechanism, and means for supplying current in phase with said generator and current in phase with said rotating body respectively to said motor.

908,939. Superheater-Boiler. John E. Bell, New York, N. Y., assignor to The Babcock & Wilcox Company, New York, N. Y., a corporation of New Jersey. Filed June 6, 1906. Serial No. 320,368. Renewed April 4, 1907. Serial No. 366,411. 1. A water tube boiler having transverse steam and water



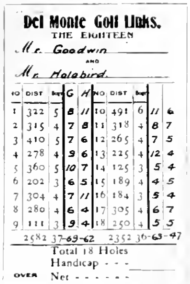
drum connected by banks of tubes to a lower mud drum or drums, a superheater located in the boiler setting over the steam and water drums, and baffling arranged to direct the gases successively over water tubes thence up over the superheater and thence down and over other water tubes of the boiler, substantially as described.

908,981. Trolley-Pole Attachment. Herman W. Eichbaum, Los Angeles, Cal., assignor of one-half to John Beckman, Rhyolite, Nev. Filed March 28, 1908. Serial No. 423,851. 1. The combination with a trolley-pole and a trolley-wire, or a contact member arranged adjacent to the trolley-wire and



having electrical connections with an object to be electrically actuated, a mechanically operated contact member carried by the trolley-pole and having electrical connection through the car with the aforesaid object to be electrically actuated, and fluid pressure means for placing said contacts in the path of one another, whereby the circuit is closed on the passing of the car.

THE BATTLE OF DEL MONTE



Del Monte Golf Links.
THE EIGHTEEN
Mr. Goodwin
AND
Mr. Holabird.

NO	DIST	BGY	G	H	NO	DIST	BGY		
1	322	5	8	11	10	491	6	11	6
2	315	4	7	8	11	318	4	8	7
3	410	5	7	6	12	265	4	7	5
4	278	4	9	6	13	225	4	12	4
5	360	5	10	7	14	125	3	5	4
6	202	3	6	5	15	189	4	4	5
7	304	4	7	11	16	184	3	5	4
8	280	4	6	4	17	305	4	6	7
9	111	3	9	4	18	250	4	5	5
	2582	37	69	62		2352	36	63	47

Total 18 Holes
Handicap - - -
OVER Net - - - - - -

THE WINNING SCORE CARD

THE Electrical Jobbers' Association of the Pacific Coast held a meeting at the Hotel Del Monte, Del Monte, California, January 17th and 18th, with a full attendance from Seattle, Los Angeles and San Francisco. A golf tournament, a little dinner and a business meeting were the three principal events.

Sunday, the 17th, was a beautiful day, bright and sunny, and the Del Monte links, famous for their scenic beauty, were in an ideal condition for the match.

Fourteen members were entered, but owing to the failure of Mr. H. V. Carter of Los Angeles to reach the battle field on time, the actual starters numbered thirteen.

In view of the fact that a number of the players had had no previous experience in playing the game, the work of the handicapping committee was largely a matter of guess work which threw an air of uncertainty about the result comparable only to an impenetrable San Francisco fog.

Play started promptly at 10 o'clock in the morning and for three solid hours the contest raged. Clods of earth sailed through the air, balls with various colored dots were lost, some of them forever, hands were blistered and curses suppressed. After it was all over and the smoke cleared away the count showed that W. L. Goodwin of San Francisco was the winner, with A. H. Elliott of Oakland a close second.

The trophy was a handsome cup of burnished copper with silver handles and rim. It will be lettered with the name of the winner, who will hold it for ninety days, after which it goes to the winner of the next tournament.

The following figures give the result in detail:

The Score.

Players	Actual Strokes	Handicap	Net
Coolidge, P. H.	105	Scratch	105
Davis, R. J.	106	+4	110
Carrigan, Andrew	106	+4	110
Holabird, R. D.	109	4	105
Berry, W. S.	120	15	105
Scribner, E. M.	122	10	112
Goodwin, W. L.	132	45	87
Elliott, A. H.	144	54	90
Gilson, C. L.	153	54	99
Woodward, F. H.	159	54	105
Hillis, C. C.	159	54	105
Bibbins, T. E.	160	27	133
Knoche, G. A.	167	54	113

AFTER THE BATTLE. RESTING ON THE STEPS OF THE HOTEL DEL MONTE.

In the afternoon another contest was held, which, however, was without any incentive in the way of a prize in which Mr. Goodwin to prove his claim succeeded in reducing his score and gave promise of golf playing ability of a high order.

Sunday night the jobbers dined in a private room of the hotel, where, seated at the round table, the trophy was transformed into a loving cup for the time being, and, filled to the brim, was passed and repassed while toasts to the winner and remarkable tales of what might have been filled the air.

Mr. H. V. Carter, T. E. Burger, and Arthur Ballard of Los Angeles did not reach Del Monte until Sunday night, while the Seattle party made up of Mr. E. N. Fobes, P. J. Aaron, and W. S. Brown was delayed by the storms in Northern California until Monday. It was unfortunate that circumstances made it impossible for them to be in attendance at the tournament and dinner, but it assured a full attendance at the business meeting which was held on Monday.

Two business sessions were held and at the afternoon meeting the following officers were elected to serve during the ensuing year:

Chairman—Andrew Carrigan, San Francisco.

Secretary—A. H. Elliott, Oakland.

Executive Committee—C. C. Hillis, San Francisco.

The session ended Monday night, the members from the north returning to San Francisco in a private car attached to the Los Angeles flier.

W. L. GOODWIN
Winner of the Del Monte Cup.

The presence of women in the party added greatly to the success of the meeting. Mrs. Andrew Carrigan, Mrs. W. S. Berry, Mrs. G. A. Knoche, Mrs. F. C. Vaughen, and Mrs. T. E. Burger taking a great interest in the field sports particularly.

The next meeting and golf tournament will be held in about ninety days and will be of unusual interest, as handicaps will be based on the Del Monte record, and the new players will undoubtedly find their work cut out for them in their efforts to maintain the records they have established.

Notes of the Game.

From the standpoint of actual strokes, P. H. Coolidge made the record both morning and afternoon. His morning score was 105, which in his afternoon play he cut down to 102.

Andrew Carrigan—"Saint Andrew of the Links"—tried hard to convince the handicapping committee that they had used good judgment in making his handicap "plus 4," but failed.

Fourteen players were originally scheduled to start, but H. V. Carter of Los Angeles failed to arrive and reduced the number to thirteen. It is somewhat of a coincidence that Mr. Carter's handicap was 23.

W. L. Goodwin, winner of the trophy, had R. D. Holabird for a playing partner and won the match with a set of clubs belonging to E. M. Scribner. Proper coaching and good clubs will sometimes accomplish wonders.

Albert H. Elliott, who holds the ping pong record, explains his loss of the match by the fact that he played the first four holes with the wrong end of the club. After this defect in his playing was corrected he made wonderful strides and evolved a system of play that is unbeatable—providing the handicap is large enough.

During the business session Monday afternoon, F. C. Vaughen of the Schenectady office of the General Electric Company and E. M. Scribner played an 18 hole match which Mr. Vaughen won, four down. Mr. Scribner feels that his being beaten was owing entirely to his lack of direction and failure to secure distance.

SUCCESSFUL RESULTS WITH BRIQUETTED COAL.

A bulletin on the comparative tests of run-of-mine and briquetted coal on locomotives and on a torpedo boat will be issued within the next two weeks by the Technologic Branch of the U. S. Geological Survey. The author of the bulletin, W. F. M. Goss, consulting engineer of briquet tests, gives the results of the tests in the following words:

1. The briquets made on the Government's machines have well withstood exposure to the weather and have suffered but little deterioration from handling.

2. In all classes of service involved by the experiments, the use of briquets in the place of natural coal appears to have increased the evaporative efficiency of the boilers tested.

3. The smoke produced has in no test been more dense with the briquets than with coal; on the contrary, in most tests the smoke density is said to have been less when briquets were used.

4. The use of briquets increases the facility with which an even fire over the whole area of the grate may be maintained.

5. In locomotive service the substitution of briquets for coal has resulted in a marked increase in efficiency, in an increase of boiler capacity, and in a decrease in the production of smoke. It has been especially noted that careful firing of briquets at terminals is effective in diminishing the amount of smoke produced.

6. In torpedo boat service the substitution of briquets for coal improves the evaporative efficiency of the boiler. It does not appear to have affected favorably or otherwise the amount of smoke produced. The briquets used in this series of tests were of a form requiring considerable bunker capacity for their storage, but as the form of the briquet is a detail entirely within control, this objection need not apply to the use of the briquets in actual service.

The binding material in all the briquettes was water-gas pitch. This material was furnished at the briquetting plant of the United States Geological Survey, in St. Louis, at $9 per ton, or 0.45 cents per pound. The least amount of binding material that would make perfect briquets was found to be 5 per cent of the weight of the coal. The cost of the binder in one ton of the 5 per cent briquets was therefore 45 cents.

The results of the tests justify the following conclusions:

(a) The evaporation per pound of fuel is greater for the briquetted Lloydell coal than for the same coal in its natural state. This advantage is maintained at all rates of evaporation.

(b) The capacity of the boiler is considerably increased by the use of briquetted coal.

(c) Briquetting appears to have little effect in reducing the quantity of cinders and sparks; the calorific value of these, however, is not so high in the briquetted as in the natural fuel.

(d) The density of the smoke with the briquetted coal is much less than with the natural coal.

(e) The percentage of binder in the briquet has little influence on smoke density.

(f) The percentage of binder for the range tested appears to have little or no influence on the evaporative efficiency.

(g) The expense of briquetting under the conditions of the experiments adds about $1 per ton to the price of the fuel, an amount which does not seem to be warranted by the resulting increase in evaporative efficiency.

(h) With careful firing, the briquets can be used at terminals with a considerable decrease in smoke.

(i) The briquets appear to withstand well exposure to the weather, and suffer little detorioration from handling.

INDUSTRIAL

NEW BUILDING OF THE FOBES SUPPLY COMPANY.

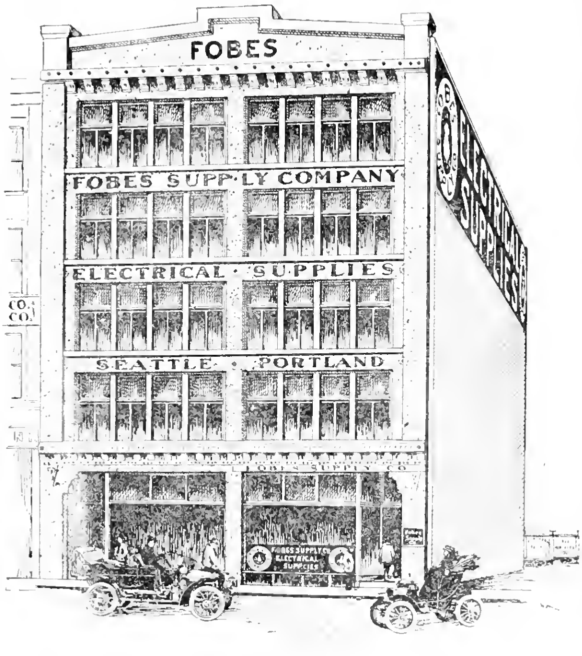
The Fobes Supply Company of Seattle and Portland recently reached the point where they found their business outgrowing their old quarters and being unable to find a satisfactory building in the rapidly growing city of Seattle were compelled to erect a five story structure for their own occupancy.

The Fobes building on First avenue South, Seattle, is one of the best examples of modern concrete and fireproof construction in the city. The building occupies a ground space 45x150 feet, and has been completed to five stories and basement, although designed to be eight stories high when finished. The final area will be 54,000 square feet.

The building is as fireproof as it can be made. There is not a piece of wood in its walls, beams or floors. The openings are protected by Kinnear rolling steel doors, also Standard doors; while the windows are of wire glass.

The roof is covered with P. & B. standard roofing; the walls are coated with Pabco damp proof compound and the elevator made water tight with Malthoid and canvas.

The front on First avenue is finished in pebble dash and Moravian tile. This is the only building in Seattle having this combination of finish on solid concrete.



FOBES BUILDING, SEATTLE

The Fobes Supply Company, dealers in electrical machinery and supplies of all kinds, own and use the major portion of the building. It is also the new home of the Paraffine Paint Company, W. L. Rhoades, Northwestern manager.

Two freight elevators in the rear and one passenger elevator conveniently located in the front furnish quick transportation to the upper floors.

The Fobes Supply Company are now comfortably installed in their new building and in position to maintain their established reputation for good servce.

WESTINGHOUSE STEAM ENGINES.

While there have been important power extensions in turbine equipment, the steam engine business of the Westinghouse Machine Company has been fairly active. Some of the contracts recorded in the last few months are as follows: Byron Jackson Iron Works, San Francisco, Cal., three compound engines for centrifugal pump drive. Kentucky State Hospital, Frankfort, Ky., three compound engines for central light, heat and power plant. Central Islip Hospital, Central Islip, L. I., two engines, and The Johns Hopkins Hospital, Baltimore, Md., three engines, both for isolated plants. Chicago, Minneapolis & St. Paul R. R., one engine for railroad shop plant. T. A. Gillespie Company, contractors, one engine for construction work. Black Hills Traction Company, Deadwood, S. D., one engine for railway power plant.

PACIFIC ELECTRIC HEATING COMPANY AT CHICAGO ELECTRIC SHOW.

The exhibit of the Pacific Electric Heating Company of Ontario, California, at the Electrical Show held in Chicago during the past week was in charge of Mr. H. F. Holland, manager of the Chicago branch. The principal feature of the exhibit was the new automatic cutout iron. This iron is an entirely new departure of anything heretofore produced in the way of electrically heated sad irons. This automatic cutout attachment is a mechanical device, and is in no way operated or influenced by a thermostat. It is built into the iron and so constructed if the iron is left in circuit without being used, whenever the iron reaches a point above the working temperature, a spring is released which throws the iron switch plug entirely off of the iron, and this plug may not again be inserted until the temperature has lowered enough to set the mechanism, when the spring will again engage, and this operation will be indefinitely repeated, thus entirely eliminating any possibility of the iron causing a fire, as it is impossible for the current to reach the iron without the spring being reset and the iron plug again attached.

Besides these automatic cutout irons, there was a large exhibit of their standard famous Hot Point iron. The most distinctive feature of this iron is the fact that two heating elements are used and are placed in the iron in such a manner as to deliver a sufficient amount of heat directly into the front of the iron to maintain a working temperature at the point when the iron is in actual service. It will be readily seen that the demand for heat in the point of any laundry iron is so much greater than the demand upon any other part of the working surface, that it is necessary, in order to maintain an even working temperature all over the face of the iron, to deliver considerably more heat to the point than to the balance of the iron. To the above well known construction a number of new features are included in the 1909 model, among which are the following:

Heretofore, the heating elements in this iron have been held in place by riveting the metal in the corners of the iron over the heater core projections extending into the corners. Hereafter the same contact will be maintained with the corners of the iron, but the elements will be held in place by

a clamp which will take the place of riveting, and make the operation of removing or renewing the heating elements a very simple one indeed. The switch plug will be enclosed in a very strong, sheet steel case so that breakage from any sort of abuse will be well nigh impossible. The popular stand attached to the heel of the iron will be built in box form so as to fully enclose and protect the terminals at the rear of the iron.

Fires are caused only after electric irons have reached a temperature of from 900 to 1500 degrees Fahrenheit, so that with this automatic iron, there is a wide margin of safety. This automatic feature also protects the heating elements from being overheated and injured thereby. It also overcomes any waste of current due to allowing the iron to remain in circuit when it is not in actual service.

There was also a display of large pressing and tailor irons in which the heat may be adjusted to three distinct temperatures. This is the only iron on the market whereby the current consumption is absolutely reduced in proportion to the three degrees of heat required. Several of these automatic cutout irons and the three tailor irons have been in constant operation under most severe conditions, during the past six months, and have proven entirely satisfactory in every respect.

El Tosto received a prominent place, as this toaster was the first to come on the market and the constantly increasing sales would indicate it is the most popular, and by its simple construction and being built with an open coil, it does not rise to a high enough temperature to cause oxidization, is consequently free from burnouts and has thus won for itself the confidence of all who have purchased same.

The electric curling tong heater is also by a class for itself in as much as it requires no cord but is screwed into any electric light socket and the curling tongs, of any size, are held in place by a spring and heat very quickly, with less than one ampere of current.

The company showed a full line of other devices, such as air heaters, foot warmers, chafing dishes, percolators, etc. To meet the demands of the Eastern trade, they have recently established a complete factory in Chicago where all of these devices are manufactured.

ELECTRICITY IN A PAPER MILL.

An important contract for electrical machinery has just been closed by the Oxford Paper Company, of Rumford Falls, Me., with the Western Electric Company. The machinery purchased includes five motor generator sets consisting of 5,500 h. p., 2300 volt induction motors, driving 330 K. W., 230 volt, direct current generators, with motor driven exciters and a thirteen panel switchboard. Power is to be taken from the line of the Rumford Falls Power Company, which is increasing its plant for that purpose. Everything is of the most modern type and designed to include the latest improvements in apparatus of its class.

This electrical machinery is to be used in a large new [illegible] which the Oxford Paper Company is now building at its [illegible] for its own use. Bleach [illegible] soda by a new electrolytic process in[illegible] Whiting of Boston and developed under [illegible] three years to a point where [illegible] a high degree of efficiency. The [illegible] used for manufacture [illegible] as an agent and [illegible] It is said to be ex[illegible] of power and to re[illegible] operation. A [illegible] and [illegible] of this [illegible]

FUSES AND FUSES.

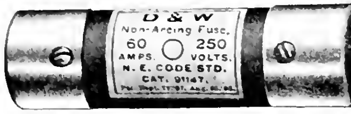
The D. & W. Fuse Co., the first in the field, began marketing an enclosed fuse in 1896. The quick recognition which was accorded this cartridge fuse was good evidence of its engineering value and this judgment has since been amply sustained in practice, while the action of the National Board of Fire Underwriters, in recommending the approval of none but enclosed fuses, places the official seal of approbation upon an ingenious and important invention.

Enclosed fuses of different makes have of necessity many external features in common, and in the new National Electrical Code Standard fuses, all superficial dimensions for each

range are fixed by the code and must be adhered to by the various makers, so it is to the internal construction that we must look for the distinguishing characteristics of the successful fuse.

In the design of the link, which is the vital portion of the fuse anatomy, there are several important objects to be attained. It must be accurate in rating and certain to blow on the specified overload, without getting too hot. On short circuit it must open immediately without flash or undue noise, and show no tendency to hold an arc. It must not deteriorate from continued use at its rated load, nor be seriously affected by external variations in temperature.

These necessary features are ingeniously secured in the D. & W. fuses by the use of their original patented interior construction, which completely satisfies the requirements of the most severe service. The smaller fuses are constructed with the air drum, a patented device, which enables the overload blowing time of the fuse to be predetermined with a high



degree of accuracy. By its means the time element of the fuse can be carefully adjusted to suit the service for which the fuse is to be used and this is most important in the protection of air governors, controllers, heating and lighting circuits.

In the larger D. & W. fuses are used the patented multiple-strip and cylinder links, which, exposing as they do the maximum surface for radiation to the filling, enable the volume of metal to be reduced nearly 40% below that of the ordinary strip links. This decrease in the amount of metal is of the greatest importance in determining the behavior of the fuse on severe short circuit as fuses of this design operate with a mere hiss where non-tubular links explode with violence.

During their investigations they subjected fuses of this construction to the most severe tests which have probably ever been imposed on any enclosed fuses, they being blown on direct short circuit between the third rail and the structure of the Interborough Rapid Transit Company's system with enormous generator capacity feeding the line. Under these conditions, the "D. & W." was the only fuse from the designs submitted by the various manufacturers, which successfully withstood the test. Other features of design in the D. & W. fuses are worked out with equally successful results, while the details of manufacture have been constantly perfected during thirteen years of actual experience, so it is with reasonable pride that the present line is offered to the trade by this company.

PRODUCER GAS POWER EXTENSIONS.

Cia Azucarera del Panuco, Tampico, Mexico, has placed an order with the Westinghouse Machine Company for a complete producer gas-electric power plant. This initial installation will consist of a vertical, 3-cylinder single-acting engine and a 150 h. p. suction producer, designed to operate on small anthracite coal. The use of the suction producer in such large sizes has proven thoroughly practicable and considerable business is anticipated along this line. Even larger sizes of producers of the suction type are contemplated by the [illegible]. The New York Standard Watch Company of Jersey City, N. J., also operate a suction producer gas plant of [illegible] size, and recently added another unit to their plant. A number of contracts have been let for gas engines operating temporarily on natural or illuminating gas with the intention of later changing over to producer gas operation. A [illegible] plant has been ordered by Seaver & Company, Chelsea, Mass., and by the Cambridge Gas Company, Cambridge, Mass. The Shelbourne Falls, Mass., Electric Light Company have [illegible] the power gas system, and have ordered a [illegible] h. p. Westinghouse suction producer for anthracite coal.

EXHIBIT OF THE CUTLER-HAMMER MANUFACTURING COMPANY CHICAGO ELECTRICAL SHOW.

The exhibit of the Cutler-Hammer Manufacturing Company, of Milwaukee, is devoted entirely to [illegible] push-button switches and sockets. None of the [illegible] lines of motor starters and [illegible] are shown in [illegible] own booth, but these devices [illegible] being shown in connection with the exhibits of [illegible] manufacturers and [illegible].

At the entrance to the Cutler-Hammer booth is a [illegible] working model of their push-button switch [illegible] glass so that the operation of the simple [illegible] mechanism can be plainly seen. On pushing the [illegible] button a row of incandescent lamps flash their rays on a sign at the back of the booth.

Numerous lamps and electroliers installed in the booth serve to illustrate the practical applications of Cutler-Hammer push-button specialties.

Push-button porcelain lamp sockets are shown in connection with tungsten lamps, the operation of the push-button lighting the lamp without tilting it or jarring the delicate filament.

A two-circuit pendent switch is shown in connection with an 18-lamp electrolier, one button controlling six lamps and the other twelve, thus making it possible to obtain by means of a single switch three degrees of illumination—six, twelve or eighteen lamps, the full candlepower of the electrolier being obtained by pressing both buttons. This same two-circuit switch is also shown in connection with an electric fan and lamp, each being separately controlled by different buttons of the same pendent switch.

Several new devices are also shown, among these being a flush switch which will be shortly placed on the market. This switch has the same simple mechanism as the other devices, the elimination of a multiplicity of parts enabling the manufacturers to meet the modern demand for a really shallow flush switch. Electric candelabra equipped with tiny push- button switches are also exhibited and a number of photographs and colored drawings illustrating various applications of Cutler-Hammer push-button specialties add to the attractiveness of this booth.

Representatives in attendance were: R. M. Van Vleet, R. [illegible] Phillips, Horace L. Dawson, Chas. J. Klein, H. P. Jones.

TURBINE BUSINESS.

The Westinghouse Machine Company reports good progress during recent months in the steam turbine business despite the general depression existing in the machinery market. While business has been considerably below normal, there ha[illegible] [illegible] [illegible] power [illegible] [illegible] [illegible] these power we find the [illegible] traction [illegible] and a fair demand [illegible] industries, in [illegible] works and [illegible] refineries [illegible] steam turbines is [illegible] equipments [illegible] for. The [illegible] are as follows: Metropolitan Street Railway, Kansas City, [illegible] Narragansett Electric Light [illegible], Providence, R. I. [illegible] Capital Traction [illegible] Washington, D. C. [illegible] Akron, [illegible] Tampa, Florida, Electric [illegible] Pressed Steel Car [illegible].

[illegible] Denver, Colo. [illegible] Gas and Electric [illegible] N. Y. [illegible] Ala.; Fall [illegible] Falls Electric [illegible] Falls [illegible] Bayonne, N. [illegible] Gas and Electric [illegible].

THE NOLEAK INSULATOR.

A [illegible] the leakage [illegible] is illustrated [illegible]. As shown [illegible] consists of two parts [illegible] at all [illegible] wire and pin. [illegible] not enter [illegible] insures good insulation, particularly in a wet country. It is stated to obviate all troubles usually occurring with fog. This insulation is the invention of Mr. Leonard W. Stonor, of San Francisco, whose practical experience with the Postal Telegraph Co. showed him its necessity. It is to be manufactured by the Brookfield Glass Co., of New York City.

NOLEAK INSULATOR

NEWS NOTES

ILLUMINATION.

PASADENA, CAL.—The City Council has rejected the offer of the Edison Electric Company to sell its plant for $250,000, and has begun preparations to call a bond election for $150,000, to be devoted to the extension and maintenance of the municipal lighting plant.

ROSWELL, N. M.—At a recent mass meeting of the citizens of Roswell, the advisability of the city owning its own electric light plant was discussed and it was decided that a petition will be presented to the City Council, asking for a bond issue in the sum of $18,000.

FRESNO, CAL.—Manager Wishon of the Fresno Light and Power Company states that preparations are being made by the company to develop its system for the distribution of power to the towns of Clovis, Sanger and Lemoore.

OROVILLE, CAL.—Continued heavy rains caused the new dam of the Oro Light and Power Company at Philbrook Valley to burst last week, releasing a flood of ninety million cubic feet of water.

EUREKA, CAL.—As a result of the very high water in Eel river the town of Ferndale in Northern California has been without light for a number of days. The storm caused the fall of the heavy cables of the North Mountain Power Company, entailing a loss of several thousand dollars.

HEALDSBURG, CAL.—Sealed bids will be received to February 1st by the Board of Trustees to build an addition to the power house at Gird ranch.

MADERA, CAL.—W. H. Parker, who, with C. E. Trink, wishes to erect and maintain a gas plant in this city, announces that 225 of the necessary 300 applicants for gas have been received. The plant is expected to be in operation early next summer.

MESA, ARIZONA.—The South Side Gas Company has been granted a franchise to erect and operate a gas plant in this place.

ST. HELENA, CAL.—Henry Brown has been granted an electric lighting franchise for a term of fifty years.

OGDEN, UTAH.—Word has been received by Secretary Reynolds of the Weber Club to the effect that Henry L. Lee, the engineer who recently investigated the outlook for a gas plant in this city, has reported very favorably to the New York Company which holds the franchise for a new gas system in Ogden.

LOS ANGELES, CAL.—Rumors are prevalent to the effect that the electric light, power and gas interests of Southern California are to amalgamate, it having been stated late last week that only a few minor details in the plan remain to be worked out. It is stated that the financial formulas in the premises are already written, with the Edison Electric Company and the Huntington-Kerckhoff interests each equally affected, the Los Angeles Gas & Electric Company to have about half the interest of the two former concerns. Such an amalgamation, if consummated, will mean a holding company with a capital of about $50,000,000.

ST. HELENA, CAL.—Henry Brown has been granted a franchise to erect poles, wires and appliances for the distribution of electric power for light, heat and power to the town of St. Helena.

TRANSPORTATION.

FRESNO, CAL.—It is expected that the survey of the proposed electric line between Fresno and Hanford will be begun within a week and that work of construction will be begun by February 1st. A large supply station is being erected in Fresno where the supplies for the road are to be stored as they arrive from the East.

NAPA, CAL.—M. C. Gintean of Los Angeles, has been chosen as traffic manager of the San Francisco, Vallejo and Napa Valley Electric road, to succeed L. J. Perry, who resigned on the first of this month. The new manager is already in charge.

RENO, NEVADA.—The fact that the Reno Interurban Company has removed its cars and that the Nevada Transit Company is now running on the interurban tracks has given renewed life to the report that the transit company has bought the interests of the interurban system. Various reports are made by officials of both companies in denial of any deal of this nature.

SAN JOSE, CAL.—The San Jose Traction Company has applied to the City Council for a franchise for the construction of a street railroad. The application has been taken under consideration by the Council.

BERKELEY, CAL.—This city will have electric cars running on the tracks of the Southern Pacific Company, according to Assistant General Manager Scott, who has charge of the conversion of the company's steam roads to electric. Where the road requires double tracks through the Berkeley streets the streets will be widened four feet in order to gain more roadway.

PASADENA, CAL.—Horace M. Dobbins states that construction on the new line between this city and Los Angeles will begin next summer.

LOS ANGELES, CAL.—As a result of the transfer of title of the old Cycleway right-of-way between Pasadena and Los Angeles, which was made to the Pasadena Rapid Transit Company, a rumor is getting about that the air-line between the two cities is allied with the Los Angeles Pacific Railway Company.

STOCKTON, CAL.—Morris L. Brackett has secured rights of way from Modesto to Riverbank for the San Joaquin Valley Electric Railway Company. He has obtained similar concessions for this road from Stockton to Modesto. Work on the road from Stockton to Modesto will commence immediately.

WILMINGTON, CAL.—The Pacific Electric Railroad Company has begun work on its line between Wilmington and San Pedro. The franchise was granted two years ago and the company has but two months in which to complete the line.

SANTA BARBARA, CAL.—The Santa Barbara Consolidated Railroad Company has been granted a franchise for a street railway along Bath street.

SACRAMENTO, CAL.—The Board of Trustees is ready to grant franchises to the Northern Electric and Central Traction roads to construct their lines through this city to the water front. The franchises are being prepared.

SALT LAKE CITY, UTAH.—President Simon Bamberger of the Salt Lake & Ogden Railroad has gone East to close the contracts for the installing of electric power on that road between this city and Ogden.

FRESNO, CAL.—Ground will be broken for the Fresno Hanford Interurban Railway by February 1st, and the road will probably be in operation by July 1st. The road is to be constructed at a cost of $1,000,000.

LOS ANGELES, CAL.—H. F. Vollmer has petitioned the City Council to offer for sale a twenty-one-year franchise for an electric street railway line on Fifty-fourth Street, the line to be an extension of the Hoover Street line.

LOS ANGELES, CAL.—Sealed bids will be received by the Supervisors up to January 18th for the sale of an electric street railway franchise for a line along Washington Street.

SALT LAKE CITY, UTAH.—Plans for the installment of electric equipment on the Salt Lake and Los Angeles Railroad will be considered by the directors on January 12th, the meeting to be held in this city. According to estimates the cost of equipping the road with electricity would be near $300,000. Should the improvement be undertaken it is said the work would be completed by July of this year.

OAKLAND, CAL.—New mechanical equipment has been installed on all controlling cars of the Key Route trains, making it impossible for a sleeping or dead motorman to operate the train. With the new automatic apparatus, the motorman must constantly keep his finger pressing the button that controls the brakes of the train. When the pressure is relieved the air brakes become set.

CHIHUAHUA, MEX.—The local electric street car company began the putting out of rails and materials this week to be used in the extension of its road out the Avenida Zarco.

GOLDFIELD, NEV.—Active work was commenced this week upon the construction of an electric line to connect Goldfield with Columbia and Diamondfield.

LOS ANGELES, CAL.—A company has been formed and a line between this city and Pasadena will be built. It is to be an elevated line, with steel coaches and with the third-rail electrical equipment.

RENO, NEV.—S. M. Wheeler and Charles Burke will begin work on the construction of a street railway line from the Southern Pacific depot into the southeastern end of the city.

FINANCIAL.

RED BLUFF, CAL.—In the suit of W. H. Gurnsey to restrain the Northern California Power Company from maintaining a power line along a public highway over his lands, Judge Ellison has rendered a decision in favor of the plaintiff.

SAN FRANCISCO, CAL.—An official of the Northern California Power Company states that the annual showing will amount to about $30,000 net earnings, of which $10,000 will go into dividends and $20,000 to surplus. The company expects to double its output by July 1st.

REDLANDS, CAL.—A report of the Home Gas & Electric Company shows a gain of 78,000 k. w. of electricity during December, 1908, over the same month in 1907, the electric business of 1908 almost trebling that of 1907. The gain was made largely on power. With the numerous contracts for pumping to be filled this year the capacity of the plant will be taxed. The increase in gas output for 1908 was 2,000,000 over the previous year.

MODESTO, CAL.—A bond election is to be held in this city and among other improvements to be considered will be the issuance of bonds in the sum of $15,000 for the extension of the water mains.

SAN FRANCISCO, CAL.—For the month of October, 1908, the gross earnings of the United Railroads of San Francisco amounted to $609,042, an increase of $177,460 as compared with October, 1907. The gross earnings for the ten months ending October 31st amounted to $5,677,343, an increase of $1,865,246 over those of the corresponding period in 1907 The net earnings for October increased $141,450 over October of 1907

MADERA, CAL.—An election will be held on January 7th, to vote on the proposition of issuing bonds in the amount of $25,000, $18,000 to be used in the purchase of a sewer system, and $7,000 for the acquisition of necessary extensions to the system, and $50,000 for the construction of a municipal waterworks.

PASADENA, CAL.—Plans for the completion of the municipal lighting plant calling for a bond election of $150,000, have been presented to the City Council by C. W. Koiner. The plans also call for the purchase of the overhead distributing system of the Edison Electric Company, the competitor of the municipal plant.

INCORPORATIONS.

LOS ANGELES, CAL.—The Hamilton Oil & Gas Co., with a capital stock of $100,000, has been incorporated here.

SAN LUIS OBISPO, CAL.—The North Alamo Oil Company has been incorporated here with a capital stock of $200,000 The directors are C. A. Adams, Thomas Preisker, W. C. Oakley, C. L. Preisker, and C. W. Smith.

HANFORD, CAL.—The Carrie Nation Oil Company has been incorporated in this city with a capital stock of $25,000, by L. H. Byron, J. H. Freer, A. J. Whitesides, A. B. Buckner, and F. P. McAdam.

LOS ANGELES, CAL.—The Standard Gas and Electric Fixture Company has been incorporated here with a capital stock of $25,000 by L. C. Cook, E. B. Armstrong and C. E. Montgomery.

BAKERSFIELD, CAL.—The North McKittrick Oil Company has been incorporated in this city with a capital stock of $500,000. The directors are, J. T. Jacobson, E. J. Sullivan, F. Hall, E. H. White and W. B. Beaizley.

BAKERSFIELD, CAL.—The Kern Midway Water Company has been incorporated by J. H. Sheridan, J. M. Dunn, F. M. Worthington, S. V. West and T. M. Young.

HANFORD, CAL.—The Uno Oil Company with a capital stock of $25,000, has been incorporated here by W. C. Reilly, R. L. Peeler, E. A. Webb, A. E. Webb and E. W. Robinson.

FRESNO, CAL.—The Nevada Petroleum Company has been incorporated here with a capital stock of $1,000,000 by M. L. Requa, F. W. Bradley, J. S. Wallace, A. C. H. Fletcher and C. A. Norris.

PRESCOTT, ARIZONA.—The Yacapai Water Company has been incorporated with a capital stock of $50,000. The incorporators are W. J. Mulvenon, M. B. Hazeltine and Thomas C. Job

BAKERSFIELD, CAL.—The Bed Rock Oil Company has been incorporated in this city with a capital stock of $50,000 by B. T. Dyer, Mrs. Mable H. Dyer, O. G. Myers, Mrs. M. P. Myers and W. L. Leland.

BAKERSFIELD, CAL.—The Arica Oil Company has incorporated here, capital stock of $500,000, by G. Sheridan, W. A. Sloan, R. T. Fisher, L. E. Westrich, L. E. Westrich and W. E. Buck.

PASADENA, CAL.—The Pasadena Rapid Transit Company has been organized in Pasadena with a capital stock of $3,000,000, by G. H. Hayes, W. H. Smith, F. J. Sheehan, D. C. Porter and Mr. Dobbins.

SANTA ANA, CAL.—The Coyote Hills Oil Company has been incorporated with a capital stock of $900,000, by C. V. Hall, John Sharp and others.

SAN FRANCISCO, CAL.—The Templor McKittrick Oil Company has been incorporated in this city with a capital stock of $3,000,000, by J. H. Hollywood, F. A. Anderson, W. N. Howes, N. F. Nelson and J. W. Jordan.

LOS ANGELES, CAL.—The Gas Operating and Construction Co. has been incorporated with a capital stock of $10,000, by G. R. Moffet, J. W. Nottingham and C. S. S. Forney.

LOS ANGELES, CAL.—The Tidewater Crude Oil Company, with a capital stock of $3,000,000, has been incorporated by W. E. Donaghoe, L. O'Neal, R. H. Burton, W. O. Emerson, W. M. Hiatt, B. K. O'Neal and F. L. Emerson.

LOS ANGELES, CAL.—The La Costa Oil Company has been incorporated in this city with a capital stock of $1,000,000, by R. A. Blair, G. E. Banks and J. W. Whitham.

TRANSMISSION.

PHOENIX, ARIZONA.—Engineer L. C. Hill states that 26,0000 h. p. can be relied upon in the Salt River reclamation project. A total of nine plants will be constructed to supply this amount and will constitute a chain between Roosevelt and Phoenix. Plants 1, 5 and 9 will comprise the initial supply of power.

YREKA, CAL.—By extending its line from Montague to Dunsmuir the Siskiyou Electric Light and Power Company will be enabled to furnish power and light to five more towns in Northern California. Work has already commenced and the company expects to finish the extension by June 1st. The mines of the Klamath river section will be supplied with power through seven miles of the new line. Gazelle, Edgewood, Weed, Sisson and Shasta Springs will be served through the new extension.

SONORA, CAL.—N. Spaulding has appropriated 5,000 inches of water to be used in the generation of electrical power for general purposes.

SANDPOINT, IDA.—The Pend d'Oreille Electric Company, the controlling interest in which is owned by Jerome L. Drumheller of Spokane, is to be bought by a group of Chicago capitalists who have become interested with Mr Drumheller in the development of the power sites on the Moyea River.

PORTLAND, ORE.—A. B. Crosman, tenth floor Board of Trade Building, is one of the Portland Water Power & Electric Transmission Company, recently incorporated. He states that the purpose of the company is to appropriate the waters of the Clackamas River for the purpose of generating power and electric power. Twenty-five thousand horsepower will be developed. Machinery for the above has not been contracted for as yet. W. H Hurlburt, Board of Trade, is the active head of the company.

OIL.

SAN FRANCISCO, CAL.—The Supreme Court has reversed the decision of the lower court in favor of the plaintiff in the case of the Graciosa Oil Company against the County of Santa Barbara. The action was brought to recover taxes assessed to the oil company, and which had been paid under protest.

BAKERSFIELD, CAL.—The Mount Diablo Oil Company has commissioned J. W. Brisco to sell its property for a million dollars in round figures. Although no sale has been made, it is reported that negotiations are pending.

BAKERSFIELD, CAL.—The Alladdin Oil Company has executed a lease of its land to E. W. Preston of Fresno County, for a term of 20 years. The lease provides for the drilling of at least five wells to a depth of not less than 2,950 feet and reserves a quarter royalty to the lessor, drilling to begin within thirty days.

LOS ANCELES, CAL.—Two Companies have been formed in this city to operate on concessions of Indian lands near Lender, Wyoming. One concern is headed by M. M. Gilchrist, the other being under the management of George Mitchell.

LOS ANGELES, CAL.—The Union Oil Company's annual meeting will be held on the third Thursday of January at Oleum. Many important matters will be taken up at this meeting.

RIVERSIDE, CAL.—The Elsinore Oil and Gas Company will purchase a standard drilling deep well rig with a capacity of 4,000 feet.

SAN FRANCISCO, CAL.—S. W. Wible, an oil operator of Bakersfield, was in this city for a number of days last week.

BILLINGS, MONT.—William Fitzhugh and F. D. Shields, of California, will erect a refinery to treat the oil from the Garland oil fields It is estimated that $1,000,000 will be spent in erecting and equipping the plant.

BAKERSFIELD, CAL.—The Dayton Oil Company's property in the Midway field has been leased to a party of San Francisco oil men, the principal lesses being S. L. and F. L. Lezinsky. The lease is for twenty years and one-sixth royalty basis.

SAN FRANCISCO, CAL.—The Standard Oil Company is importing foreign oil products into California at the rate of 2,000,000 gallons a month. The Standard exported over $2,000,000 worth of refined petroleum products from San Francisco during the fiscal year 1907 to 1908.

BAKERSFIELD, CAL.—The Union Oil Company has closed negotioations for the property of the Sunset Road Oil Company in Sunset and Midway fields.

RHYOLITE, NEV.—Prof. T. W. Green, representing an Eastern syndicate, has purchased 640 acres of oil land from Al McCausland and his associates. According to reports from this field, many indications of the presence of oil are to be found, including fossil rock, paraffine, clay, asphaltum and shale. For fifteen miles along the railroad between Rhyolite and Las Vegas the ground has been located, and machinery has been ordered by the company represented by

PHOENIX, ARIZ.—The Potomac Oil Company, operating at Bakersfield, Cal., has re-organized and at a recent meeting here the following directors were elected: B. M. Lovell of Los Angeles, Lafayette E. Pike and Joseph P. Tuttle of Hartford, Conn., Edwin H Clark of Litchfield, Conn., and John H. Osgood of Bakersfield.

SANTA BARBARA, CAL.—The California Liquid Asphalt Company, whose refinery has been operating at Summerland for eight years, will abandon the local field and move its plant to San Luis Obispo County

LOS ANGELES, CAL.—The Union Oil Company has purchased 740 acres in the Sherman section of Los Angeles field. Through the acquisition of this property the Union Company will assume control of the Consolidated Oil Corporation.

WATERWORKS.

OAKLAND, CAL.—In a decision handed down by Judge Waste last week it was intimated that the Spring Valley Water Company will be restrained from taking artesian water from Pleasanton Valley and delivering it to the consumers of San Francisco. The decision was given in suits brought by Pleasanton Valley ranchers, who claim that the wells sunk by the Spring Valley Company have caused their artesian wells to go dry and in that way ruining their crops.

LOS ANGELES, CAL.Sealed bids will be received by the Board of Public Works up to January 15th for furnishing the city with steel for tunnel forms.

LOS ANGELES, CAL.—Sealed bids will be received by the the office of the City Clerk up to January 19th for furnishing galvanized pipe and fittings for the park department of the city.

SACRAMENTO, CAL.—Bids for 8,400 feet of 6-inch cast-iron pipe will be received at the office of the City Clerk up to January 25th.

SAUSALITO, CAL.—Forty-year bonds in the sum of $100,000 for the installation of a municipal fresh water system have been ordered issued by the Trustees. The Trustees have decided to bring suit against the Sausalito Spring Water Company for the forfeiture of its plant on the ground that the company has violated its charter by selling water to outside consumers, while residents of the city have been on a short allowance.

SAN FRANCISCO, CAL.—The Supervisors have authorized the Public Works Commission to enter into a contract for the purchase of pipe, fire hydrants, gate valves and other appurtenances of the proposed auxiliary fire protection water system. The sum to be expended has been limited to $1,850,000.

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INDEX TO ADVERTISEMENTS

ASBESTOS

Johns-Manville Co., H. W.

BATTERIES

DRY BATTERIES

Dean Electric Co.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

DRY BATTERY HOLDERS

Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES

Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY

Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

STORAGE BATTERIES

Elec. Storage Battery Co.
Westghse Machine Co.

BELLS

ELECTRIC BELLS

Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

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Edwards & Co.
Electric Goods Mfg. Co.
Marshall Elec. Co.
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MAGNETO BELLS

Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
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Standard Elec. Wks., "C & S"
Western Electric Co.

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Henshaw-Bulkley & Co.
Keystone Boiler Wks., "Parker."
Moore & Co., Chas. C., "B. & W."
Standard Electrical Works, "Robb-Mumford."
Tracy Engineering Company, "Edge Moor."

BOOKS

Technical Book Shop.

BOXES

WALL BOXES

Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knock-out."
Chicago Fuse Wire & Mfg. Co., "Union."
Cole Co., John R., "Bossert."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
General Electric Co.
Harvard Elec. Co.
Holabird-Reynolds Elec. Co.
Marshall Electric Co.
Standard Elect'l Wks., "M & M."
Stanley & Patterson, Inc., "Simplex."

BRACKETS

CEILING BRACKET AND DESK FIXTURES

Stanley & Patterson, Inc., "Sunlight."

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Sterling Elec. Co. "Equipoise."
Western Electric Co

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Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Cutter."
Pierson, Roeding & Co.
Western Elec. Co, "Fletcher"

BURNERS

ELECTRIC GAS LIGHTING BURNERS

Electric Goods Mfg. Co., "Advance."
Edwards & Co.
Welsbach Company.
Western Electric Co., "Edwards."

CABLES

SUBMARINE AND LEAD-COVERED

American Electrical Works.
Belden Manufacturing Co.
Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
National Conduit & Cable Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
Standard Electrical Works, "Simplex."
Standard Underground Cable Co.
Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

PAPER INSULATION

Belden Manufacturing Co.
Nat'l. Conduit & Cable Co.
Western Electric Co.

TELEPHONE CABLE

Dean Electric Co.

CARBONS

ARC LIGHT CARBONS

Brooks-Follis Elec. Corp'n, The, "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The, "I-T-E," "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
Kierulff, Jr., & Co., B. F "Hartman."
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co

CLEATS

FIBRE CLEATS

Blake Signal & Mfg. Co.

PORCELAIN CLEATS

General Electric Co.
Holabird-Reynolds Elec. Co., "Electric Porcelain."
Thomas & Sons Co., R.
Weber Elec. Co., H. D. Sears, general sales agent.
Western Elec. Co., "Thomas"

WOOD KNOBS

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CLUSTERS

FIXTURE CLUSTERS

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Hubbell, Harvey, "Hubbell."

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Western Electric Co., "Delta-beston."
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Electric Goods Mfg. Co.
Western Electric Co.

COMPOUNDS

BOILER COMPOUNDS

Dearborn Drug & Chemical Works.
Johns-Manville Co., H. W., "Magic."

CONDUIT

FLEXIBLE CONDUIT

American Circular Loom Co., "Circular Loom."
Cole Co., John R., "Circular Loom."

RIGID CONDUIT

American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct," "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roeblings Sons Co., J. A. "Navalite."
Cole Co., John R., "Electroduct."

UNDERGROUND CONDUIT

Johns-Manville Co., H. W., "J.-M."
Pierson, Roeding & Co., "Fibre."
Roeblings Sons Co., J. A., "Bituminized Fiber."
Walworth & Neville Mfg. Co.
Western Electric Co., Agents Walworth & Neville Mfg. Co.

CONDUIT CLAMPS

Krantz, H., Mfg. Co.

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CABLE CONNECTORS

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Simplex Elec. Co.
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American Electrical Works.
Belden Mfg. Co.
Elec. Appliance Co., "Paranite."
General Electric Co.
Okonite Co., The "Okonite."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roeblings Sons Co., John A
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Std. Elec. Wks., "Simplex."
Standard Und. Cable Co.
Western Elec. Co., "Victor."

TELEPHONE CORD

Belden Manufacturing Co.
Dean Electric Co.
Kellogg Sw'b'd & Supply Co
Kierulff, B. F., Jr. & Co. "National."
Pierson, Roeding & Co., Agts Elec. Cable Co.
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Standard Elec. Works, "Simplex."
Western Elec. Co., "Victor."

CROSS ARM BRACES

Benicia Iron Works.
Kierulff, B. F., Jr. & Co.

CUT-OUTS

ARC CUT-OUTS

Bryant Electric Co.
Ft. Wayne Electric Works.
General Electric Co.
Perkins Elec. Switch Mfg. Co.
Westghse Elec. & Mfg. Co.

INCANDESCENT CUT-OUTS

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.
Weber Elec. Co., H. D. Sears, general sales agent.
Westghse Elec. & Mfg. Co.

TRANSFORMER CUT-OUTS

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.
Westghse Elec. & Mfg. Co.

DYNAMOS

ALTERNATING CURRENT DYNAMOS

Allis-Chalmers Co., "Bullock."
Fairbanks, Morse & Co.
Ft. Wayne Electric Works.
General Electric Co.
Standard Electrical Works, "E. M. Co."
Western Electric Co.
Westghse Elec. & Mfg. Co.

DIRECT CURRENT DYNAMOS

Allis-Chalmers Co., "Bullock."
Electric Appliance Co., "Colonial."
Fairbanks, Morse & Co.
Ft. Wayne Electric Works.
General Electric Co.
Northern Electrical Mfg. Co.
Standard Electrical Works, "E. M. Co."
Western Electric Co.
Westghse Elec. & Mfg. Co.

ELEVATORS

Van Emon Elevator Co.

ENGINES

GAS AND GASOLINE ENGINES

Allis-Chalmers Co.
Moore & Co., Chas. C.
Fairbanks, Morse & Co.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Kierulff, B. F., Jr. & Co., "American Diesel Engine."
Tracy Engineering Co.
Westghse Machine Co.

MARINE ENGINES

Standard Elec. Works, "Engbery."

STEAM ENGINES

Allis-Chalmers Co.
Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Tracy Engineering Co., The
Westghse Machine Co.

FANS

DESK AND BRACKET ALTERNATING CURRENT FANS

Ft. Wayne Electrical Works.
General Electric Co., "G. E."
Standard Electrical Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

EXHAUST FANS

General Electric Co.
Standard Elec. Wks., "M. A Co."
Wagner Electric Mfg. Co.
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co

CEILING, ALTERNATING CURRENT FANS

Standard Elec. Wks., "Jandus" "Century."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

CEILING, DIRECT CURRENT FANS

Electric Appliance Co., "Colonial."
Standard Elec. Wks., "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

DESK AND BRACKET DIRECT CURRENT FANS

Electric Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co., "G. E."
Standard Electrical Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

FIXTURES

CEILING, BRACKET AND DESK FIXTURES

Benjamin Electric Mfg. Co.
Dale Co.

MARINE FIXTURES

Benjamin Electric Mfg. Co.
Dale Co.
Electric Appliance Co.
Sterling Electric Co.

SHOW CASE FIXTURES

Benjamin Electric Mfg. Co.
Dale Co.
Johns-Manville Co., H. W., "Linolite."

STAGE FIXTURES

Chase-Shawmut Co., "Shawmut."

FUSE MATERIAL

ENCLOSED FUSES AND FITTINGS

Bryant Electric Co.
Chase-Shawmut Co., "Shawmut."
Chicago Fuse Wire Mfg. Co., "Union."
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W., "Noark."
Marshall Electric Co.
Perkins Elec. Switch Mfg. Co.
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

FUSE BOXES

Including Service Boxes, Subway Boxes and Junction Cut Outs for use with enclosed fuses.
D. & W. Fuse Co., "D. & W."
Johns-Manville Co., H. W., "Noark."

FUSE WIRE AND LINKS

Chase-Shawmut Co., "Shawmut."
Chicago Fuse Wire & Mfg. Co.
General Electric Co.
Harvard Electric Co.
Pass & Seymour.
Pierson, Roeding & Co., "Aluminum."

MISCELLANEOUS FUSES

Bryant Electric Co.
Harvard Electric Co.
Marshall Electric Co.
Perkins Elec. Switch Mfg. Co.
Weber Elec. Co., H. D. Sears Gen'l Sales Agt.

TELEPHONE FUSES

Dean Electric Co.
D. & W. Fuse Co.
Kierulff, B. F. Jr. & Co., "Sterling."
Standard Elec. Wks., "Couch & Seeley."
Western Electric Co

GOVERNORS

WATER-WHEEL GOVERNORS

Pierson, Roeding & Co., "Lombard."

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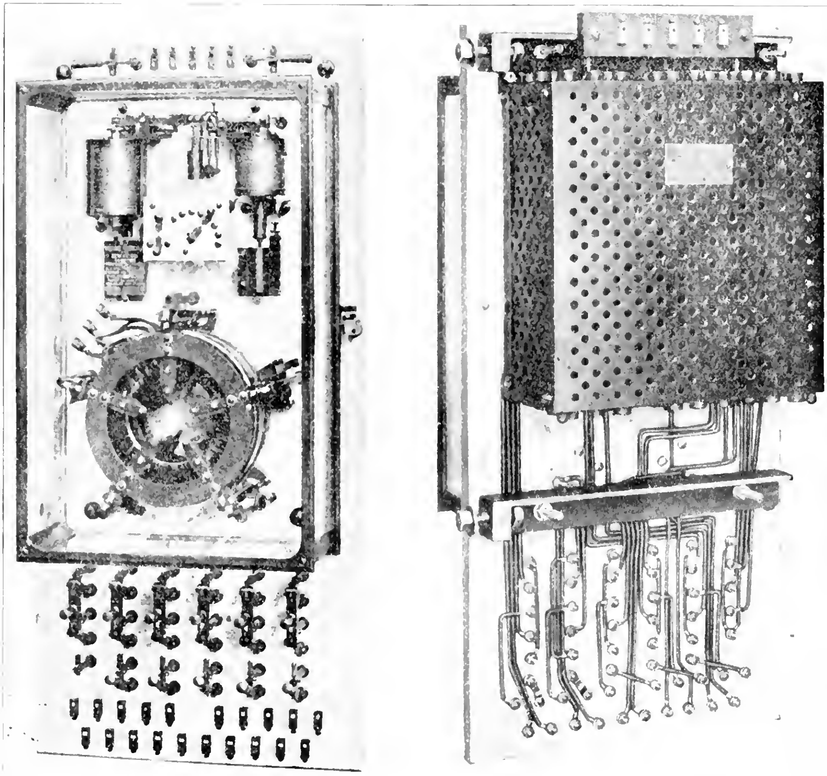
AUTOMATIC VOLTAGE REGULATION[1]

BY J. A. LIGHTHIPE

I have written this short paper, not to give any new methods of regulation, but rather to take up what we have at our hand and see how far it is advisable to make our systems automatic. I will make a hasty review of what has and what can be done with the main object of promoting a discussion. Most of us realize that one of the best assets that a company can have is continuity of service and constant potential at the distributing plant.

In the early days of the three-wire Edison plants, this fact was realized, and the stations were laid out with eight or more feeders, each with a large rheostat in series, and pressure wires run back from the ends of the feeders to the station switchboard. They picked out the heaviest feeder, and pressure wires were run from this feeder terminal to a potential indicator built on the Wheatstone bridge principle, that is an incandescent lamp was on one leg of the bridge and the change in the resistance of the carbon in the lamp, due to changes in voltage, swung the galvanometer needle to the right or left, showing the voltage high or low. The indicator was sensitive enough to make a change of one volt move the needle an inch. The rest of the feeders were equipped with differential galvanometers which showed



Tirrill Regulator.

[1]Paper read at December meeting of the Los Angeles Section of the American Institute of Electrical Engineers.

high or low in comparison with the standard feeder. As the load came on, another pair of dynamos was thrown in multiple with those running, the potential being guessed at by a pilot lamp on top of the dynamo, and a dynamo tender that could throw in another pair of machines without throwing off the belt or bending the ampere-meter needle was an expert and got his diploma. They afterwards bridged the feeder end with heavy copper and did away with the rheostats; then on account of the excessive drop on some of the long feeders, they used an auxiliary bus and somewhat higher potential, and threw the low feeders on it.

During this stage of the art, there were many attempts to automatically raise or lower the potential at the bus bar as the load called for, but most of them worked very restlessly and erratically and were invariably dispensed with after a short trial, going back to the faithful, tireless, sleepless operator.

About this time the single phase, high frequency, alternating current system came out with 1,000 volts, four times the potential, one-sixteenth of the drop; the problem was solved, we did not have any drop and therefore perfect regulation. We found afterwards that there was a drop of about 8% in the transformers that were then made. We also found that we could not run these machines in multiple and had to use double-throw switches to throw the feeders on from one machine to the other. This gave a bad wink and from what I see every night about 10:30, I do not believe that Los Angeles has outgrown the habit. These machines were finally compounded, which helped out the drop considerably.

About this time I ran a series of incandescent lamps for the city lighting, each lamp being bridged by a small compensator. We knew how much current the lamps would take and were informed that the compensator took nothing, and ran into the paradox of our lamp load not jibing with our ampere meter. This was four years before power factor was born. When we started to run our systems by water power there was no governor worthy of the name, and all our regulation was made through the gate. I remember when somebody wired Mr. Mitchell, the Portland representative of the Edison Electric Company, for his opinion of the best water wheel governor, he wired back, "A tachometer and a Chinaman."

With the advent of our polyphase transmission plants, the question of regulation drifted from the power house to the substation. In the Sacramento-Folsom plant, one of the first plants installed, the center of the city was taken care of by a low tension, four wire, three phase, Y neutral system at 200 volts, and the centers of the distribution were taken care of by eight feeders, each with a single phase regulator on each wire of each feeder. The feeders were run very symmetrically on the poles, and pressure wires were run under each wire back to the station and connected to volt meters. The wiring looked fine, but the results were fierce. We got over our difficulty by using three wire cable for pressure wires and transposing our feeders. We still depended upon our tireless operators for good regulation. About this time, we found that three synchronous motors that were installed in the Sacramento substation were a great help to us, we could raise or lower our system with field of the motors, changing our power factor leading or lagging. As our substation grew larger and more complicated, various means of regulation were adopted. Taps on our transformers, compensators, and induction regulators, some singlephase and others polyphase.

With the introduction of the Tirrill regulator, we had a regulator that was almost instantaneous in its action. These were installed in the power plant and by the use of compensated voltmeters we began to get better results. It was automatic. Then we tried to make our synchronous motors regulate automatically. Mr. F. G. Baum devised and installed in the Piedmont substation in Oakland a device connecting the series coil of the exciter around a shunt placed in the main d. c. bus bar. This helped the regulation at the substation but the application was limited. With the Tirrill regulator attached to the synchronous motor we have the means to automatically use the synchronous motor to regulate our potential and by means of a compensated voltmeter keep our potentials at our centers of distribution constant. This placed on our main feeder and automatic motor driven regulators on the other feeders will give almost perfect regulation.

About four years ago I set up an experimental Tirrill regulator in the power house of the Oakland Gas, Light & Heat Company. This regulator was connected with the exciter of a 500 k. w. motor generator set. A Bristol recording voltmeter was installed to watch the effect. After waiting about half an hour without seeing any great change in the excitation, I telephoned the sub-station of the Standard Electric Company to raise the voltage of the transformer taps until I told them to stop. Inside of 15 seconds the synchronous motor had 100% overload in kilovolt amperes. The operator at the substation then telephoned that either his voltmeter or the switches were out of whack, as he could not raise his potential a volt.

Our feeders should all be provided with quick acting circuit breakers and the main trunks with time-relay cutouts. With long transmission lines I would recommend automatic switches and reverse current relays at the substations. With only two lines the reverse current relay is useless if the short on one line is near the station, as we would have practically zero voltage and both sides are liable to go out. With three lines, you have the two lines to help throw the bad one out. If we are afraid that we cannot build a switch to open 20,000 k. v. a. at 100,000 volts, let us use the switch to bridge an explosive fuse which we can build to break almost unlimited k. v. a. or potential. If we cannot get a switch this year, we will have it next year.

Ten years ago when we built the Santa Ana River plant we used selected switches because it was an impossible problem to devise a switch that would break 33,000 volts and 4,000 kilowatts.

I have brought out these facts to start a discussion, as many of you have had a good deal of experience with both automatic devices and hand operation. I believe that we can operate all our lines automatically better, quicker, safer and more reliably than by hand.

DISCUSSION.

A. S. Glasgow—I feel that the subject of potential regulators is one on which we have given too little thought. This is due probably to our exceedingly rapid growth which has caused us to concern ourselves more with providing a source of current and a means of getting it to a market, than to the refinements of the distributing systems. Of course, every man connected with the operating department of our various lighting companies desires regulators and prefers them automatic, if obtainable. The management, however, is quite liable to consider such devices a luxury, but a little calculation is all that is necessary to change their minds. For instance; suppose we have a lighting feeder circuit on which there is a peak load of 100 k. w. in incandescent lamps for two hours each evening. Now suppose that the voltage on this current is 7½% low. This means that the power taken by this lamp load is 85.5 k. w. instead of 100 k. w. as it should have been had the potential been normal. In one year this means a loss in gross revenue, at 9c per k. w. per hour of \$952.00, or about \$400.00 in net revenue. This would nearly cover the cost of the regulator.

R. J. C. Wood—The best regulator we have is copper, plenty of copper, but it is an expensive one. There will come a time in the life of every feeder when no amount of automatic regulation at one end will be sufficient. The voltage may be kept perfect at one point, while at others lamps are either being burned out or giving poor light.

With regard to the Tirrill regulator, I wish Mr. Lighthipe had said more about it. I am afraid of it for long transmission lines. Suppose a short occurs on the line, the Tirrill, not being quite human, thinks it is simply a case of very bad voltage and proceeds at once to build up the generator fields to the limit. The speed of the generator also drops. Now if the short breaks, the voltage instananeously jumps to an abnormally high value. The Tirrill may act quickly enough to prevent the voltmeter

from showing the full extent of the rise, but the rise will be there.

I believe a good regulator for transmission lines should be of the Tirrill type, but have a relay or cut-out that would lower the voltage if it once dropped to, say 50% of normal, the Tirrill to work in the ordinary way from 50% or normal voltage up. We have a Tirrill regulator at Santa Barbara on a mixed light and railroad load, and its operation is all that can be desired. The voltage is held very steady and builds up automatically for the evening peak, the regulator being compounded for this effect.

E. F. Scattergood—The author of the paper expresses his belief that "we can operate all our lines automatically, better, quicker, safer and more reliably than by hand." If I understand the meaning, it is not that we can do this with the apparatus which we have at present, but that in many instances we can, and that with constant effort on the part of engineers and manufacturers, apparatus can be developed to take care of other conditions with equally good success, with which I believe the most of us will agree. Again, if I understand correctly, Mr. Lighthipe's attitude in presenting this paper, is to encourage efforts on the part of engineers in developing automatic apparatus; making their wants known to the manufacturers and demanding apparatus which will successfully take care of them, pointing out the defects and demanding that they be remedied. Certainly his past work would indicate that he at least will do his share of such pioneer work or development and would gladly have others do theirs, which we should do.

The two general forms of automatic apparatus which have been referred to are circuit breakers for disconnecting feeders or portions of a system in trouble for the protection of the whole, and apparatus intended to control the voltage on different feeders or different portions of such an electric system.

It is the function of the engineer to determine in each case, what automatic apparatus is called for and desirable, adapting that already on the market, if at all suitable, and striving to vary it or attempt something entirely new if conditions justify or require it, and rather than attempt to go into details or particular instances or particular makes of apparatus, I would rather be permitted to attempt to picture before the meeting, an expensive electric system similar to those in this section, consisting of numerous sub-stations or secondary distributing points in various parts of the larger cities and in various surrounding cities and towns; main distributing points, with auxiliary steam plants in connection therewith, and hydro-electric power plants located at distant points. Speaking first of automatic circuit breakers of the fuse or switch type, as the case may require, but probably entirely of the air or oil switch type, we would have at such sub-stations feeders controlled by automatic breakers. It would seem without question, lines or feeders from the main distributing points to such sub-stations or similar high tension lines from sub-station to sub-station, in many instances, should be controlled by automatic breakers, but preferably in most instances with a time element. This especially applies in case two or more sub-stations are connected on the same feeder from the central distributing point.

A complicated high tension electric system, be-sprinkled with automatic breakers, without the quieting effect of the time element judiciously applied, is suggestive of nerves to say the least, and more interruptions to service and high insulation strains may be experienced than without any automatic feature.

Just a suggestion or two in regard to voltage regulation. At substations referred to or at entirely independent but small generating plants, low tension feeder regulators are essential to good service in lighting covering any considerable area and often a desirable addition to a power feeder. Successful automatic regulation has been attained for these conditions and it rests with the engineer to say whether circumstances justify it in each instance.

In connection with the regulation of the system as a whole from the central distributing point, we should keep in mind the importance of striving to keep the current on the various transmission and high tension distributing lines as low as possible, approaching unity power factor as nearly as it is practicable. There is no question that considerably more energy is being lost in such lines, "as air cooled copper rheostats" than we sometimes realize. This is especially true of the long distance transmission lines from the hydro-electric plants and can be cared for very nicely in connection with the generators at the auxiliary steam plants in conjunction with synchronous motors where such are desirable both at the main distributing points and at sub-stations.

In the purchase of generators at auxilliary steam plants, it would suggest itself therefore, that they have k. v. a. capacity in excess for this purpose. Synchronous motors are not desirable in too small units and not desirable except where an attendant would otherwise be required, but in large units and with attendants necessarily present, they will help out a great deal. The tendency towards induction motors on the part of users of power is, I believe, more fortunate than otherwise as giving more satisfactory service and less trouble to the power company.

The auxilliary steam plant and large synchronous motors can be depended upon to take care of this power factor very well and assist in regulating the bus voltage at the main distributing points, as well as at such sub-stations as have them.

The power factor on the long distance transmission lines being thus raised to practically unity, automatic voltage regulators placed at the distant power house are without doubt very desirable and can be set to regulate the voltage to compensate for line drop and for as much more as may be desired, these regulators being very satisfactory in their operation as at present on the market.

J. A. Lighthipe—At the Edison Electric plant we float a 2,000 k. w. steam driven turbine unit over the peak to help out the power factor and this greatly improves our regulation.

H. Wiatt—The question of how far automatic regulation can be carried on our electric system, is one which opens up a wide field for speculation. If the conditions considered could be held stationery for a time, and allow the matter of regulation to catch up, as it were, it would be possible to make a better showing, but this would not be progress. All the details of electrical production have been, and are being so refined and improved that as progress is made with regulation, the requirements become more exacting. Much more is being accomplished in the matter of regulation today, than was even attempted at the beginning of things, of which Mr. Lighthipe has written in his paper under discussion, and yet regulation is comparatively as far from perfection today as at that time. It is probably generally conceded that automatic would be preferable to hand regulation. Although much has been accomplished in this line to date, the performance of automatic regulators leaves much to be desired, and also leaves much to be performed by the tireless, sleepless, more or less reliable attendant, to whom Mr Lighthipe refers, and must still at times come on the scene to save the day, as of yore. Considering the ordinary commercial system, composed of an extensive field of small consumers, the demands of each varying from the other in particulars which makes their regulation impossible to handle from any one point, the subject of regulation becomes an extremely complicated one. The subdivision of such a system into as many circuits as practicable, with a potential regulator, on each circuit, reduces the extent or rather the range of variation in drop, and is a long stride toward the desired end; and yet these individual circuits are still hampered by their varying local conditions, which are as yet unprovided for. As to how far automatic regulation can be carried, this is realized to be a question impossible at this time to answer. However, the progress and success of automatic regulation to date justifies great hopes for the not far distant future.

V. L. Benedict—The Tirrill regulator is the simplest and most effective generator regulator yet developed. It has three magnets, one of which is across the exciter voltage; another is across the a. c. voltage through a potential transformer, with also

an accumulative wound coil which is in series with the a. c. line through a current transformer. These two magnets act on plungers, the other ends of the pivoted levers making floating contact with each other. This contact closes or opens one of the differentially wound coils of the relay magnets, both of which coils are across the exciter voltage, one being connected permanently. When one coil is opened, the other overpowers a spring and breaks the contacts of a short circuit across the exciter field rheostat. Thus, if the a. c. voltage is too low the floating contact closes, demagnetizing the relay magnet, and the spring that closes the contact, and the exciter rheostat being short-circuited, boosts the exciter voltage. This regulator may be applied to any generator or to any exciter. It is preferable, however, to have low densities in the iron of the exciter so that the shunt field current will not increase more than about 30% when the exciter voltage increases from 125 to 150.

By varying taps on the current transformer, the regulator can be adjusted to maintain constant potential at a desired distant point in the distributing system at any power factor or load. The regulator may have its current transformer placed in one of a group of feeders; thus, a feeder regulator for that circuit is not needed. If some feeders should need 5% compensation and some 10% the Tirrill regulator may be adjusted for 5% and the few feeder regulators required may be one-half the size required if no Tirrill regulator were used. This regulator can be used up to 12 small exciters, or a fewer number of large exciters. On these large machines the field rheostat is divided into sections and each section is short-circuited by a relay contact. If a Tirrill regulator be used with a synchronous motor solely for regulating the power factor of a distributing system, the power factor at one half load should be unity, the motor taking lagging current at lower loads and leading current at higher loads, the adjustment being to take full amperes lagging at no load and full amperes leading at full load on the system.

The motor should have a short circuit current as a generator of at least three times full load current, in order, with 100% change of excitation to be used at full load current leading or lagging.

The Tirrill regulator with its automatic variation of the exciter voltage, gives the ideal method of applying a synchronous motor as a power factor regulator, at the receiving end of a transmission line. This point is being more carefully considered by operating engineers, than heretofore and has been brought out by the discussion very forcibly. The additional cost of a synchronous motor over an induction motor is well worth the difference in view of the additional generator capacity made available by increasing the power factor. This is extremely important on systems which are short of power.

If only 5% of the full load current is available for regulation of the power factor, this would mean 95 k. w. output and 31 leading k. v. a.'s for correction of power factor with normal heating at full load output. The most economical point to use the synchronous motor for energy output and phase control at the same time, is 71% output energy and 71% wattless current, heating being that at full load current.

Wooden insulator pins for telegraph and telephone use are in little demand. Eucalyptus pins made by a manufacturer at San Jose, are of a special type soaked in paraffine and used for power purposes only. The demand and production are limited. There is a strong objection to eucalyptus pins for standard work owing to the brittleness of the material and its liability to break under considerable strain. It is also an expensive wood to work in manufacture, owing to its hardness. The majority of the pins used upon the Pacific Coast are of locust, $1\frac{1}{2}$ inches in diameter and 9 inches long. All of these are made in the East, and cost about $16.00 per thousand. Seconds and culls can be bought for about $2.00 per thousand less. These pins are manufactured in the locust region in the East by the million and as the field for their sale on the Coast is limited, it is doubtful whether any local manufacturer can compete.

WATER HAMMER IN PIPE LINES.

By S. L. Berry.

The question of water hammer in pipe lines is a very interesting and important one, and it is desirable that we have as clear and accurate notions of it as possible. That formulae which neglect the compressibility of water lead to erroneous results can be understood by the statement that instantaneous stoppage of flow in a perfectly incompressible fluid confined in a perfectly rigid vessel would give an infinite pressure. That is the limit in one direction, while in the other we find that either complete compressibility of the fluid or complete elasticity of the vessel would prevent any hammer action at all.

Neither limit exists in the problem under consideration and we will find the actual conditions and results somewhere between them. A formula considering only the compressibility of water is used, and is the simplest of any proposed, but the results are too high, and a related assumption gives erroneous results when used in connection with slow closing of the valve.

On the other hand, a formula which considers only the pipe dilation ignores the well known fact of the compression of water and gives results higher than those found by experiment. The primary investigations of this subject were made by N. Joukovsky in 1897, at Moscow, preliminary to the installation of extensive water works. An account of these was presented by O. Simin at the 1904 meeting of the American Water Works Association and published in the Proceedings for that year.

These experiments are so important and far-reaching in their results that they should be studied by every engineer interested in a clear understanding of the subject.

The decrease in volume of water due to an increase of pressure of one atmosphere as given by Grassi (see Gibson's Hydraulics and its Applications) increases from 0.000040 to 0.000051 as the temperature decreases from 212° F. to 35° F. This gives a bulk modulus varying from 368,000 to 288,000 lbs. per sq. in., the value at 50° F. being approximately 300,000 lbs. per sq. in.

These are the figures for pure water, and will be used in the following examples, although the presence of air in solution increases the compressibility and would reduce the resulting pressure. The amount of pressure above normal due to stoppage of flow is so related to the velocity of the pressure wave that it is necessary to know something about this.

The velocity of sound waves in any medium depends upon the elasticity and density of the medium. According to the formula given by I. P. Church:

$$C = \sqrt{\frac{Eg}{\gamma}} \qquad (1)$$

the temperature remaining constant. In the case of water,

$E = 300{,}000$ lbs. per sq. in.

$g = 386.4$ inch seconds.

$\gamma = 0.03604$ lbs. cu. in. (wt. of water).

$C =$ velocity of pressure wave in inches per second.

and we would have a velocity of 56713 inches per second or 4726 feet per second. This result is variously given and depends upon the temperature which may happen to be considered the average one, and would represent the condition in a rigid pipe line.

What happens on instantaneous stoppage in a rigid pipe is given by Gibson to be as follows: rise of pressure above normal and zero velocity at lower end; a wave of pressure and zero velocity starts from lower end and travels to upper end at a velocity of 4726 feet per second; the compressed column immediately commences to re-expand on arrival of the wave at the top, the pressure drops to normal at that point and a wave of normal pressure and velocity ($-v$ up the pipe) travels to the lower end; on reaching the lower end it is reflected as a wave of negative pressure (below normal) and zero velocity, to be again reflected at the top as a wave of normal pressure and velocity (v) in which v is the original velocity of the water.

This cycle is repeated until the motion dies out, due to a combination of causes.

It will be seen that the increase in pressure is equal in all parts of the pipe, and that the only influence exerted by the length of the pipe is in fixing the time occupied by the wave of pressure in traversing the line.

The persistency of the high pressure at the lower end in seconds

$$= \frac{\text{length of pipe x 2}}{4726}$$

and at any point on the line will be equal to the time required by the wave to travel from the point to the top end and return.

The time for a complete cycle

$$= \frac{\text{length of pipe x 4}}{4726}$$

The time element is important, as any time required to close the valve which is equal to or less than

$$\frac{\text{length of pipe x 2}}{4726}$$

gives the same effect as instantaneous closing.

This is the reason why long pipe lines are more difficult to protect than short ones, and not because they contain a greater weight of water.

The formula for pressure produced in a pipe by stoppage within the limits given and not considering elasticity of the pipe walls is

$$p = v\sqrt{\frac{E\gamma}{g}} \qquad (2)$$

in which

p = pressure in lbs. per sq. in.

E = Bulk modulus of water = 300,000 lbs. sq. in

γ = 0.03604 lbs. cubic inch (wt. of water).

g = 386.4 for inch seconds.

v = velocity of the water in inches per second.

This reduces to

$p = 5.29\ v$ (inch seconds).

or for velocities expressed in feet per second

$p = 63.48\ v$ (foot seconds). (3)

This is a simple formula but gives higher results than when elasticity of the pipe walls is considered, and the formula above for velocity of the pressure wave gives a shorter time within which the results are the same as for instantaneous closing.

That the velocity of sound in a compressible medium contained in an elastic pipe is less than for a rigid pipe was first proven by Korteveg in 1878, was confirmed by calculation and experiment by Joukovsky, and is accepted as having an important influence on results obtained.

Church's formula for the velocity of the presure wave considering the compressibility of water and the elasticity of the pipe walls is

$$C^1 = \sqrt{\frac{g}{\gamma} \cdot \frac{E\,E^1\,t}{t\,E^1 + 2\,r\,E}} \qquad (4)$$

in which

C^1 = velocity of pressure wave in inches per second considering elasticity of walls.

g = 386.4 (inch second).

γ = 0.03604 lbs. cu. in. (wt. of water).

E = Bulk modulus of water = 300,000 lbs. sq. in.

E^1 = Modulus of elasticity of material of pipe walls.

= 30,000,000 lbs. sq. in. for steel.

= 25,000,000 lbs. sq. in. for cast iron.

t = thickness of pipe wall in inches.

r = radius of pipe in inches.

Using the same notation and making v the velocity of the water at the time of closing, the pressure in lbs. per square inch.

$$p = v\left(\sqrt{\frac{\gamma\,E\,E^1\,t}{g\,(t\,E^1 + 2\,r\,E)}}\right) \qquad (5)$$

also when the velocity of pressure wave is calculated as above.

$$p = v\,\frac{C^1\,\gamma}{g} \qquad (6)$$

These formulae give a smaller value for the velocity of the pressure wave, consequently a longer time of valve closing within which the results are the same as for instantaneous closing, and a considerably lower pressure above normal, and they should be used in all cases where the best results are desired.

Any condition tending to increase the elasticity of the containing walls, as for instance, making them thinner, and providing air chambers, tends to decrease the maximum pressure, but lengthens the period of vibration. The latter may produce evil effects in governing in some instances, and is somewhat analogous to increased length of pipe, except that lower pressures are met with.

It is evident, considering a pipe line of any length, that no influence tending to check the flow at the upper end can exist until the arrival there of the wave of pressure and zero velocity; consequently the section at that point will continue to flow after closure at lower end for a time in seconds

$$S = \frac{L}{C^1} \quad \text{in which}$$

L = length of pipe in feet.

C^1 = velocity of pressure wave in feet as calculated above.

S = time in seconds.

The time S multiplied by v, the velocity in feet per second of the water, gives the distance in feet traveled by the upper section in this time, which multiplied by the area in square feet of the pipe gives the volume in cubic feet which should result from the compression of the water and the stretch of the pipe walls.

Take for example a pipe line as follows:

L = length = 2000 feet

D = diameter = 16 inches

A = area = 1.396263401595 sq. ft.

v = velocity of water = 5 feet per second

A^1 = area of pipe when expanded by pressure p

p = pressure above normal due to water hammer.

t = thickness of wall = 1/4 inch steel

V = volume of water before compression in cu. ft.

V^1 = volume of water after compression in cu. ft.

S = time in seconds required by pressure wave to reach top end of pipe line

S^1 = time in seconds of pressure wave for up and down trip

The head is not material except that it must be taken into account when deciding upon the thickness of the pipe walls

Then by formula (4) the velocity of the pressure wave

$$C^1 = \sqrt{\frac{386.4}{.03604} \cdot \frac{300{,}000 \cdot 30{,}000{,}000 \cdot \frac{1}{4}}{(\frac{1}{4} \cdot 30{,}000{,}000 + 2 \times 8 \cdot 300{,}000)}}$$

= 44285 inches per second

= 3690.4 feet per second.

And the pressure by formula (6)

$$p = 60 \cdot \frac{44285 \cdot .03604}{386.4}$$

= 247.83 lbs. per sq. in.

The pressure by formula (3) which does not consider the elasticity of the pipe walls would be 317.4 lbs. per sq. in.

The formula given by Prof. A. Budau which considers the water to be incompressible is

$$(h_0) = \sqrt{h_1^2 + \frac{3\,S}{D}\,\frac{E\,v^2}{\gamma g}} - h_1$$

in which

(h_0) = increase in pressure in feet.

h_1 = operating head in feet.

S = thickness of pipe walls in inches.

D = diameter of pipe in inches.

E = modulus of elasticity of pipe material.

v = velocity of water in inches per second.

γ = 62.408.

g = 32.153.

(This notation is to be used in this formula only and is not to be confused with that given elsewhere.)

Applying this formula to the case above and using the same

value for the coefficient of elasticity of the pipe walls, the excess pressure resulting is 606 lbs. per square inch. As the operating head is included in the formula, this was assumed at 200 feet.

Returning to the previous notation,

$$S^1 = \frac{2 \times 2000}{3690.4} = 1.08388 \text{ sec.}$$

is the time of valve closure which gives the same effect as instantaneous closing. The complete formula for pressure (p^1) due to gradual closing is complicated, but the result can be obtained with sufficient accuracy by the formula

$$p^1 = p \frac{S^1}{Tv} \qquad (8)$$

when Tv is greater than S^1; in which Tv = time of closing of valve in seconds. As noted above, when Tv is equal to or less than S^1 the pressure will be the same as for instantaneous closure.

To show whether formulas (4) and (6) satisfy the condition produced by the flow of the upper section during the time required by the pressure wave to reach the upper end of the pipe, consider the following figures:

The volume of the water in the pipe would be, before compression,

$V = A$ L.
$= 1.396263401595 \times 2000.$
$= 2792.526803190$ cu ft.

The compression of water per lb. pressure with a bulk modulus of 300,000 lbs. per sq. in. would be $\frac{1}{300,000} = .00000333$

and the compression under a pressure of 247.83 lbs.
$= .00082610$ which multiplied by V
$= 2.306906392$ cu. ft., leaving the volume compressed
$V^1 = 2790.219896798$ cu. ft

The increased area of the pipe due to expansion can be found by considering the effect of the water hammer pressure on the walls.

The diameter would increase to diameter in inches

$$= 16 + \left(\frac{8 \cdot 247.827717}{30,000,000} \times \frac{4}{1} \right) \qquad (16)$$
$$= 16.00422960 \text{ inches.}$$
$$= 1.33368580 \text{ feet.}$$

and the area $A^1 = 1.39700170$ sq ft.

The length of the expanded pipe occupied by the compressed water will be

$$\frac{V^1}{A^1} = 1997.29169 \text{ feet,}$$

which leaves a distance at the top end of 2.70831 feet which should check with the distance traveled by the upper section, while the pressure wave was traversing the length of the pipe.

The time required by the wave will be

$$\frac{2000}{3690.4} = .54194 \text{ sec.,}$$

and the distance traveled by the upper section = .54194 x 5 = 2.70950 feet, which checks within .00119 feet, or four one-hundredths of one per cent.

In Budau's treatment of the case (considering the water to be incompressible) it is not possible to obtain a correct statement of the velocity of wave propagation, but by calculating the distention of the above pipe, due to the pressure given by his formula, it is possible to find the distance traveled by the upper section of water by comparing the pipe volumes before and after dilation. From this results a value for the velocity of wave propagation which substituted in formula (6) will give a pressure checking closely with that given by formulae (4) and (6). This means, in the case cited, that a pressure of 606 lbs. per square inch is required to satisfy the conditions when compressibility of water is neglected, while 248 lbs. is sufficient when this element is included.

As water positively is compressible, the conclusion is that Budau's formula is incorrect and would lead to results not sustained by experiment. In the above example the simple formula (3) gives a result much closer to the correct one.

THE VALUE OF A WATER POWER.

The value of an undeveloped constant water power is such a sum as when put at a proper rate of interest, say 10 per cent, will pay the difference in cost between steam and water power, items of cost being considered. A power which is variable, and which cannot be depended upon throughout the year, has of course less value than that which is constant. In such a case the items for consideration are: The maximum, minimum, and average quantity of water, and length of time when there is no water; all the other items which enter into the value of a uniform power; necessity in nearly all cases for a supplementary steam plant, with the expense of maintenance and running for a portion or all of the time.

The value of an undeveloped variable power is little or nothing if its variation is great, unless it is to be supplemented by a steam plant. It is of value then only when the cost per horse power for the double plant is less than the cost of steam power under the same conditions as mentioned for a permanent power has been represented.

To determine the market value of such a power which has been developed, it will be necessary to consider the power by itself, independent of the plant; that is, to determine first the value of the power as though it were undeveloped, and then to determine the value of the improvements. The sum of both will represent the value of the power as developed.

It might happen in some cases that the value of the privilege would be a minus quantity, but that the value of the improvements more than offset that, thus making it of value in the developed state.

The cost of developing a power originally will not always represent the value of the improvements, except in so far as it relates to the character of the work done. Considering the work properly and substantially done, the value of that work immediately after completion may not be represented by its cost. A certain power may cost to develop twice as much as another of equal power, the difference in cost being due to differences in head or some other natural cause; but, all other things being equal, the one which cost double has no more value than the other, because it produces no more.

The value would depend largely, however, upon the character of the work done and the condition of the dam, canal, and wheel plant. If any portion required renewing soon, the value would be lessened; and if a general renewal of all the plant were necessary, the value would then be practically the same as though it were undeveloped.

The actual value of a plant would depend upon the amount of depreciation which had taken place; or, better, upon the number of years which it would run without renewing.

The value of the plant will be its cost, less depreciation, up to the point where the cost of water power equals that of steam power; for it would be justifiable to make an expenditure up to an amount which would give as good financial returns as any other source of power. Beyond this point, when water power costs more than steam power, the value of the improvements would not be represented by their cost.—From a paper by Charles T. Main, Mill Engineer and Architect, Boston, Mass.

A uniform system of operating accounts has been promulgated for express companies and electric railways, so far as they come under the jurisdiction of the Interstate Commerce Commission. The financial accounts for all agencies of transportation have been brought to a point at which general questions of public policy, as well as technical questions of accounting, claim consideration. In the matter of annual reports, also, many changes have been made during the past year. Such reports are now required from express companies, from electric railways, and from sleeping-car companies. The forms for reports of steam railways have been arranged so as to require a less extended report from the small railways than from the large railways. A special form of report has been advised for switching and terminal companies, as well as for lesser companies which maintain financial accounts only.

DIFFICULT PROBLEMS WHICH PUBLIC UTILITY COMMISSIONS ARE ENDEAVORING TO SOLVE[1]

By H. C. Abell.

First: The Total Value of a Property; which includes the physical or tangible value, as well as the so-called intangible value.

Second: The Proper Rate of Return on that Valuation, so that capitalists can be induced to invest in a more or less hazardous business instead of real estate, mortgages, etc.

Third: The equitable method of charging the users of the commodity and establishing standards—whether it be for a cubic foot of gas, a kilowatt of electricity, a gallon of water, a telephone call, or a car ride, so that each user pays to the Public Utility for service rendered an amount which shall bear a proper relation to the cost which he occasions the utility.

Fourth: Some method of increasing the rate of return to the Public Utility on its valuation in some proportion to the decreased cost to the public, as an incentive to the Utility to develop its business and decrease its cost per unit, and thereby decrease its selling cost to the public.

It appears at first glance that these problems should not be difficult of solution, but an analysis soon develops the perplexing and trying difficulties.

First Problem.

Total Valuations; which may be divided into physical and so-called intangible valuations.

Physical Valuation: Engineers can estimate, at prevailing prices, what it costs to replace a certain piece of apparatus, or a collection of pieces concentrated on one portion of ground or under one roof, which may be called the plant or power house, but they cannot, with the same accuracy, estimate

(a) What has been the average price paid since the utility first commenced serving the public, including the increased cost of new apparatus installed when just developed, over the later prices after the apparatus becomes standard and patents have expired;

(b) What will be and what has been the cost of necessary changes, due to the ill fitting together of these parts;

(c) What will be the changes in the art during construction, necessitating changes in plans and construction;

(d) What the increased cost will be, due to climate or labor conditions;

(e) The kind of soil and quantity of water to be encountered in all excavations;

(f) The cost of accidents, employers' liability, public liability, fire, wind, water, etc., breakage of machinery, temporary work, such as coffer dams being washed out during construction, and various other items;

(g) The increased cost of construction during operation, due to idle labor waiting for an opportunity to work, and to temporary work installed (in order to avoid interruptions to service) which is removed after permanent work is finished;

(h) The increased operating expenses, which are unavoidable due to construction work going on;

(i) The length of time necessary to construct a plant, which would affect interest while building, taxes during construction, engineering, etc.;

(j) The cost of obtaining all the actual necessary money to build the plant, and to put it on a self-sustaining basis;

(k) The unforseen litigation, injunctions, etc., which frequently increase enormously the original estimated cost;

(l) The cost of the corporate organization of the company;

(m) What the actual cost will be over the estimated cost—due to increased cost of material and labor since estimates were made, and to omissions, etc.;

(n) The necessity of laying out works, purchasing property, erecting buildings, etc., in order to provide for future extensions—at a minimum cost for the future;

(o) The present value of the plant, after depreciating the various items to allow for obsolence, inadequacy and decay, and the enhanced value, which will be considered under intangible valuation.

Intangible Valuation: It is also impossible for engineers to estimate, with accuracy the intangible valuation, which involves a consideration of

(a) The expense of obtaining a proper and efficient operating organization;

(b) The expense of maintaining an operating organization to develop business and to popularize the utility and the use of its product during the construction period, so that the plant can commence operating with the greatest possible revenue;

(c) The cost of advertising—including newspapers, posters, perodicals, personal solicitation and practical demonstrations of various kinds;

(d) The cost of appliances which are given away, or loss on their sale which includes free installation;

(e) The loss due to operation until the utility is on a paying basis;

(f) The loss in interest and profits on the investment, from the first operating period to a time when expenses and interest are earned;

(g) The enhanced value of the utility due to the increased value of its real estate, location of plant, accessibility of water, railroad facilities and sewerage, location of pipes, conduits, etc., in the streets—the latter costing much less for installation, special fittings, moving of manholes, etc., when no obstructions are met, to the extent that these items are not given full consideration in making the physical valuation;

(h) The enhanced or decreased value—due to the utility while operating having assisted and participated in the loss or development of the town or city. The utility having been an active participator in the development of the city, must be entitled to at least the same recognition as any active merchant or banker, whose business, as a going concern, is worth something; and the utility is entitled to even more consideration, since it cannot pick up its pipes, conduits, and plant and move to another city. The inactive land owner is much better off than the utility in that although he takes the same chances in the development of the city, he takes no other chances and assumes no responsibility; whereas, the utility has actively assisted in all developments, taking the many chances of loss to which only a utility is heir, including the risks involved in the work of construction, development, and financiering;

(i) The loss in the change of apparatus, due to obsolescence or inadequacy, which could not be charged as an operating expense and still maintain rates which would hold the customers and permit the financing of the company for necessary changes and extensions. One of the many examples was the changing of monocyclic generators which had been installed but a short time. An example, with which the writer is familiar, is the difference between the purchase price and the price obtained after abandonment (a change having been essential), which amounted to a depreciation of forty per cent per annum. The utility company could not possibly maintain its rates and finance this change due to evolution and development, any more than could a manufacturing concern (which had experienced the same rapid change in the art, as had many utility companies), if it were not permitted to add a charge for the cost of experiment and development to the sale price of its commodity. In the case of the utility, it is the development of the art for more efficient and reliable service in competition with other sources of supplying heat, light, etc.;

(j) The expenditures in replacing the appliances free of cost to the consumers, due to a change in the art. An example would be: a change of motors from D. C. to A. C. system, from one cycle to another, and that of operating voltage, necessitating the change of all lamps and appliances. All utility companies

[1]The Armour Engineer.

have experienced this expense, though it does not show in a replacement inventory.

The Tentative Method, now used by one of the Commissions to arrive at reproduction and present physical values, is as follows:

Reproduction Value: Five year averages are obtained from the various units which go to make up a whole; then the freight, estimated cost of installation and handling are added. To the sum of these items, which are supposed to make a completed whole, is added a percentage for engineering, interest while building, and incidentals. To the above two items is added the stock (coal, appliances, etc., on hand), and to this, the cost of paving, making a grand total for replacement. The following is a summary:

	Reproduction.	Present.
1. Land	—	—
2. Distribution System	—	—
3. Power Plant Equipment	—	—
4. Buildings	—	—
5. Office Furniture, Appliances	—	—
6. Tools, Implements and Machinery	—	—
7. Horses, Wagons and Miscellaneous	—	—
8. Total Items 1 to 7	—	—
8. Add —% for Engineering Supervision, Interest during Construction and Contingencies	—	—
Total 1 to 8	—	—
9. Stores and Supplies	—	—
10. Paving	—	—
Total Items 1 to 10	—	—

Present Value: The present value is arrived at as follows: By consultation, discussion, and investigation, a tentative life of each unit is taken; then the junk value is ascertained from values of old copper, iron, etc.; by deducting the junk value from the reproduction value, the depreciating value of the unit is obtained. The present value, if in first class operating condition, is obtained by taking the age of the unit and deducting the amount which would have accumulated in a reserve fund had an amount been set aside each year, bearing a certain per cent interest, which would, at the end of its life, have equaled the total depreciating value; its junk value is then added. If in fair operating condition, ten per cent is deducted from the present depreciating value and, if operating, but in poor condition, twenty per cent is deducted from its present depreciating value; to either of the above values would be added the junk value. To illustrate this method of arriving at present value, we may assume that the reserve fund is to be set aside at four per cent compound interest; that the cost of the unit is $1200 new; that the tentative average life is twenty years; and that the junk value is $200, and that we wish to determine the value at the end of ten years; first, when in first-class condition; second, when in fair condition; and third, when operating but in poor condition. Deducting $200 junk value leaves $1000 as the cost of the depreciable portion of the unit new. The amount to be set aside each year at four per cent, compound interest, to equal $1000 at the end of twenty years, would be $33.58. The amount set aside each year for ten years, together with its accumulated interest, would be $403.

Deducting $403 from $1000 leaves $597, to which must be added the junk value, $200, making a present value of the unit, if in good operating condition, of $797; if in fair operating condition, ten per cent is deducted from $597, making the total present value $737.30; if operating but in poor condition, twenty per cent is deducted from $597, making the present value $677.60.

Minimum service values are allowed for the various units which from point of age, might make the value of the unit equivalent to junk only, though it would be in useful operation. For instance, electric meters, which are subject to state or municipal inspection, or both, and have to be kept in a certain state of repair at all times, are allowed a minimum service value of 80 per cent of the reproduction cost; whereas, with a steam engine that has been in service a number of years but which may be in a good state of repair though not having the same efficiency as a more modern engine, or sufficiently good to put in a newly built plant, only 25 per cent of its reproduction value is allowed.

There is a great diversity of opinion among engineers as to the approximate correctness of the above method of arriving at present value.

Some engineers claim that each unit should be gone over, first obtaining its reproduction value, and then depreciating it in proportion to the cost of making the unit practically new.

Other engineers think that in addition to the above, a further amount should be deducted for depreciation in proportion to the change in the art.

Still others think that the present value of a plant should be estimated on a basis relative to most modern apparatus. As an example: Suppose it is the desire to obtain the value of a water power plant of 1000 K. W. capacity, with a load factor of 40 per cent. A figure would first be obtained for the most economical steam plant of this capacity, which, for illustrative purposes, we will assume to cost $100,000. Further assuming that the cost per K. W. hour is one cent, not including interest, and that the water power plant can develop current at ½c per K. W. hour on the same basis as that taken for steam, then the saving per K. W. hour, by using the water power plant, would be ½c, or on a 40 per cent load factor (3,504,000 K. W. hours per year), the saving would be $17,530. This sum capitalized at ten per cent (the allowable rate of return on the investment) would make the value of the water power $175,200 more than that of the steam, or give the water power a total value of $275,000. The depreciation is assumed to be included in the operating expenses.

All the above methods are influenced by the personal equation.

Second Problem.

Rate of return on the valuation: Before taking up the rate of return, I will refer to the depreciation and the amount to be set aside therefor. The line of demarcation between depreciation and maintenance is difficult to follow. Some engineers and managers think that maintenance and depreciation should all be an operating expense, as it is essential to keep a plant up to a certain point of repair at all times. They think when a piece of apparatus is replaced, the difference between the amount received for it, either as junk or an old piece of apparatus, and the cost of the apparatus replacing it, should be charged to plant account. Others think the difference between the actual cost of the old apparatus and the new should be charged to the plant account, and that the cost of the old apparatus should be charged off to an operating maintenance account. They also think that the utility enhances in value as the city develops in a larger proportion than the depreciation occurs.

Others think that an amount should be set aside each year sufficient to cover the depreciation according to assumed lives. For instance, to take the example of 1200 previously mentioned, $50.00 would be set aside each year for twenty years, if the apparatus should last that long.

There are also various opinions as to how the fund should be treated and financed.

The Commission, previously referred to, when obtaining present values, used four per cent compound interest curve, knowing that the apparatus had actually reached its present life. As to the future, however, it is difficult to prognosticate what these lives will be; in fact, we are certain that a portion of the plant will not reach the estimated lives of its several parts, and that a portion may be in useful operation long after it has from point of age reached the junk value. It would seem that an amount should be allowed that would cover the probable depreciation with reference to any specific financing of the fund, and the amount be changed, either reduced or increased, as necessity requires and actual experience teaches.

If an amount be set aside each year to cover the probable depreciation, some properties would soon be in the hands of a

receiver, as they would be unable to meet necessary obligations. Commissions will have to use their judgments in this matter.

The rate of return has to be large enough to induce men of money to invest in a more or less hazardous undertaking. The investment is certain to increase continually as the city develops.

The utility is subject to all the various municipal and state laws which may be passed and enforced, but unlike a life insurance company or other concern, it is not able to move away and still collect premiums from the residents of the state or municipality, or take all of its property with it.

Nearly every utility has strong competition, necessitating continuous changes. In fact, the competition with itself, in many instances, is very detrimental to returns on the investment. For instance, more efficient appliances are frequently brought out, using only 40 or 50 per cent of the commodity formerly used with old appliances. As the utility still has its investment, capacity and practically the same consumers' expense, it must devise methods and means for increasing the use to its present consumers, increasing their standard of illumination, etc. It is not probable that this can be done, especially to this large extent. To increase sales with additional consumers can be accomplished only with additional investment. The solution of this problem requires the most serious thought and best management.

It is almost unnecessary to make any mention of the changes which entail very heavy depreciation and enormously increased material from which the product is manufactured, increased cost of labor, the necessity of continuous operation during the expenditures, without any increase in earnings such as art, municipal regulations, liability to accident, increased cost of light as well as heavy demands, strikes, changes of plant, etc., when all other manufacturing concerns can shut down.

A public utility is a barometer of the condition of business. When factories shut down, the street railway patronage immemediately falls off, light and fuel bills are decreased, all of which means a cut from the net profits of the utility, as its fixed expenses are practically the same.

Third Problem.

Establishing standards of service which will be fair to both the consumer and the utility, and which will be paid for by the consumer in proper relation to the cost which he occasions, and at the same time allow the utility to compete with the various other forms of light, heat, travel, etc., is a problem of large and wondrous dimensions.

In order to arrive at any solution, it is necessary to consult the manufacturer of apparatus and appliances, the operator of the utility, and the user of the utility's product. The opinions and claimed experiences of persons under each head vary greatly; but still more diversified are those of the manufacturer, operator and user. By a study of the opinions, experiences and rules already in force in various places, it is possible to arrive at some tentative rules, regulations and specifications of quality, pressure, accuracy of measurement, etc. As it is the duty of a Commission to study the various variables which enter into the cost of a product, and endeavor to arrive at a saleable and purchasable mean, they have to ascertain the quality which should be supplied, which necessitates a knowledge of the material from which it is manufactured. For example, the coal available for gas manufacture may have a high percentage of sulphur, and in order to produce a gas which would compare in the amount of sulphur present to another gas from other coal, which might be very high priced but low in sulphur, would so increase the cost of gas that it would be out of proportion for the results accomplished.

The relation between candle power and calorific value varies with the different manufactured gases. For instance, to obtain the same calorific and candle power values with coal gas as is obtained with water gas, might mean an increased cost wholly out of proportion to the results obtained.

An allowable variation of gas pressure of a fixed number of inches of water, whether the pressure is high or low, might work a hardship on either the utility or the customer. By a study of the appliance and the application of the law of the flow of gas through an orifice it is possible to arrive at a mean which is fair. As an example: a rule not allowing over 1½ inches of water differential pressure on any consumer's premises would be an exceedingly close regulation and commercially impossible for a total city distribution system, though it is possible that such a regulation might, if the matter were not thoroughly understood, be inaugurated.

As the flow of gas through an orifice is as the square root of the differential pressure, therefore increasing the pressure from 1½ in. of water to 3 in. of water would increase the flow 40.6 per cent while increasing from 3 in. to 6 in. would increase the flow only 41.6 per cent, or hardly more than from 1½ in. to 3 in. Practically all appliances are built to take care of this variation of 100 per cent, especially the Bunsen or induced air draft mixer. Take the formula

$$\tfrac{1}{2}Mv^2 = \tfrac{1}{2}M^1(v^1)^2$$

v being the velocity of the gas leaving the nozzle of the inductor, v^1 being the velocity of the air and gas together after mixture. If v^1 remains constant, and v, the nozzle pressure, varies, then with about 40 per cent increase in velocity, theoretically, about 200 per cent more air will be drawn in, so, allowing for mechanical loss in efficiency of apparatus, enough air would be brought in to make the proper combustible mixture. A differential pressure of 1½ in. between initial and final pressure would pass 52,000 cu. ft. of gas through a mile of pipe, with an investment of $15,840, while a 3 in differential pressure would pass 73,000 cu. ft. of gas, or 40 per cent more, through the same mile of pipe.

From the above it can be seen that a rule specifying a certain differential pressure as 1½ in. would mean a greatly increased investment and not help the consumer much more than the 100 per cent allowable variation in pressure from a minimum which is allowed by one commission.

Even the latter allowance, if strictly followed in every case and for all hours of the day, might work a hardship on the customer and the utility by necessitating the payment of interest on a heavy investment for a very short period of use.

It can be seen that the establishing of standards and forcing the utility to comply with them in every particular, is a problem for engineer, financier and economist.

Equitable charging would have to be based on the cost of the consumer to the utility, in order that each consumer might bear his proper proportion of the expense which he occasions. As an example: a large store may have a demand of 400-16 candle power lights and only use them on an average of one hour per day; whereas, a small concern may have a demand of only 26-16 candle power lights and use them twenty-four hours per day; each would consume the same amount of current; each consumer's expense would be approximately the same; the output expense for current consumed would be approximately the same; but the capacity of the generating plant equipment, lines, transformers, etc., would be twenty times more for the large store than the required capacity for the smaller concern. It is, therefore, necessary to subdivide the expense in order to ascertain what the expense of an additional consumer will be, what the fixed expense will be per unit of capacity demanded, and the cost of the commodity per unit sold.

There are some expenses which are common only to the consumers, such as reading meters, delivering and collecting bills; others, proportionate only to output, such as coal carbonized for gas manufacturing; and still other expenses proportionate to output and capacity, such as steam. A part of the steam is used to operate exhausters, which take gas from the hydraulic main. The amount of work performed is in proportion to the gas made; whereas, the amount of steam used for heating the buildings and keeping the holder cups from freezing in the winter, is not in any way influenced by the amount of gas manufactured by that capacity of plant. To go into the several items of expense and endeavor to arrive at a correct subdivision would take considerable space. As an illustration, I will touch on one or two items:

The steam account for electric generation is very difficult of analysis between fixed and output expense. If engines were

operated continuously at the most economical load, the cost per unit generated would be less than at variable loads, which actually occur in an electric plant. Boilers are frequently banked, and all the fuel used for banking fires or starting up a boiler each day for peak loads is probably a capacity expense. Engine and dynamo labor, and frequently boiler room labor, would be no greater if all the engines were running continuously at 100 per cent load factor. It can be very plainly seen that as the load factor increases, the operating expenses are decreased per unit of electricity sold.

In order to approximate a correct proportion to be charged to capacity, it would be necessary to assume for a basis, some ideal load factor.

There is a great diversity of opinion regarding the division of General Expense which usually includes executive salaries, general office expense, general office clerical salaries, office rent, legal expense and an incidental general expense, like the publishing of annual reports, stockholders' meetings, etc. Some accountants call this a contributary or overhead expense, and divide it in proportion to the sum of manufacturing, distribution and collection expenses which are subdivided into capacity, consumers and output.

The interest on the investment is frequently subdivided in the same proportion between the capacity, consumers and output, as the example of the general expense just given.

A tentative summary of the division of Yearly Expenses for a Gas Plant are given below:

	Capacity.	Consumer.	Output.
Manufacture	$ 2,288.65	$........	$38,839.00
Distribution	7,531.79	12,929.92	1,917.00
Collection	230.66	3,775.35	....
Operating Expense, except General Expense	$10,051.10	$16,705.27	$40,756.00
General Expense	2,156.74	3,594.57	3,626.98
Depreciation	8,405.00	1,845.00	2,000.00
Rate of Return	7,460.09	12,500.69	30,445.22
	$28,072.93	$34,645.53	$81,828.20

$1.27 per meter, $8.45 per consumer, 78c per M for gas.
22,000 Meter light capacity connected, 6 cu. ft. per light.
4,100 Consumers.
105,000,000 cu. ft. of Gas Annual Sales.

From the foregoing figures the fixed charge for the various connected capacities would be as follows:

5 Light Meter per Year	$ 14.80
10 Light Meter per Year	21.15
20 Light Meter per Year	33.85
30 Light Meter per Year	46.55
45 Light Meter per Year	65.60
60 Light Meter per Year	84.65
100 Light Meter per Year	135.45

Besides the above fixed expenses the consumers should pay 78c per thousand cubic feet for gas.

A complete analysis of the consumers' accounts should now be made, together with their connected capacities for demand; then, by taking the maximum rate per unit for the commodity at that time in force, and applying the following equation:

$$A + Bx = Cx$$

it is possible to see how many of the customers should have their bills raised or lowered.

A = Yearly charge on the connected load or demand.
B = Output cost of gas.
C = Maximum rate per M. cu. ft. then in force.
x = Number of cu. ft. of gas used per year.

Example: Assume a five light meter was installed and that the maximum rate for gas was $1.25 per M. cu. ft. How many cubic feet per year would a consumer have to use in order to pay the company all expense which he occasions it, together with a proper rate of return on the investment, when the capacity expense is $6.35, consumer's expense $8.45, and output price of gas 78c per M. cubic feet?

$$A = \$6.35 + \$8.45 = \$14.80$$
$$B = 78c.$$
$$C = \$1.25.$$
$$\$14.80 + .78x = \$1.25x$$
$$x = 31{,}500 \text{ cu. ft. per year.}$$

By the foregoing method it is found that 80% of the total consumers had not been paying the amount which they should.

The difficulty of obtaining and installing rates which are fair and equitable and at the same time sufficiently satisfactory to the prospective customer who is not now, but after a proper introduction to the use of the commodity, may become a very profitable consumer, is obvious. There are many rates in use and it devolves on a Commission to study them all, together with an analysis of costs, and endeavor to arrive at something which will be the most equitable for all concerned,—a task which is more than arduous.

Fourth Problem.

To increase the rate of return to the public utility in some proportion to the decreased cost to the public.

There are several methods now used, or proposed, to accomplish the above results, based on the "London Sliding Scale," or some modification of it.

The first part of the problem is to set the initial price, which, of necessity, has to be fair, whether it be a maximum or average price per unit for all the commodity sold. After solving problems two and three, the price will be fairly well determined for an established concern. To obtain this price requires study and investigation, and a thorough knowledge of all the factors for each specific case. The cost of material from which the product is produced varies, as do practically all the factors which go to make up the cost. The price has to be sufficient to take care of any normal fluctuation, without working detrimentally to either the customer or to the utility. Whenever any abnormal variation in the price of material, etc., occurs, it has to be taken care of by some other means. Sometimes a certain per cent is set aside in a reserve fund until it reaches a certain amount—a percentage of the investment, gross earnings or some such basis. This fund is kept to take care of variations in price of manufacturing material, decreased earnings in bad years, etc.

A solution of Problem No. 2 will give the initial percentage to be allowed as a rate of return on the investment, after which the ratio of increased allowable net earnings to decrease in price, will have to be determined.

As the price is decreased it becomes more and more difficult to make further reductions, hence a Commission has to determine whether these increased premiums to the utility should be on a differential scale to stimulate greater effort on the part of the utility to improve the physical and financial service to the public, or whether some permanent arrangement should be enforced allowing a utility a fixed per cent increased net earnings, with a specific decrease per unit of the commodity sold.

Whatever method of increasing the rate of return is used, it will have to include the consideration of the availability of service, extensions in new districts, etc.

I have suggested but four general problems. As has been seen, each of these involve many intricate and difficult questions which will undoubtedly require many years of study and labor to properly solve.

The electrolytic manufacture of aluminum was commenced at New Kensington in America in 1888 and at Newhausen in Switzerland in 1889 under patents granted to Hall and to Heroult respectively. The Bradley patent for keeping the bath in a molten state, which expired last year in Europe, expires this year in America. In Europe aluminum is selling at 13 cents per pound while here it is now about 23 cents, and will undoubtedly drop when the Bradly patent becomes public property.

CURRENT COMMENT

Permits for steam pipe lines may be granted by the San Francisco supervisors, according to an opinion rendered by the city attorney.

The Kobe Street Railway Company is negotiating a loan of $500,000 with French capitalists to be used in constructing and equipping the road at Kobe, Japan.

The wireless telegraph summoned five vessels to the aid of the White Star liner Republic, which with 761 people on board, was rammed by the liner Florida, 26 miles south of the Nantucket lightship, last week.

Calcium carbide was first produced on a large scale by Wilson at Spray in the United States in 1893. Wilson's patents were not upheld in Europe owing to the earlier publication of Moissan's chemical researches upon the electrical furnace and its products.

The constitutionality of the Federal forest policy is to be tested if a measure be passed by the Colorado legislature which authorizes the attorney general to prepare cases involving the question of the unconstitutionality of Federal forest reserves within the boundaries of sovereign states.

The highest generator voltage in use is that at a hydroelectric plant at Manojlova Falls on the Kerka river in the Province of Dalmatia, Austria-Hungary, which generates electric current at 30,000 volts. This is fed direct to the line without the use of step-up transformers and transmitted twenty-one miles to a calcium carbide works.

Examination for Engineer in the Indian service, is announced by the United States Civil Service Commission on February 17, 1909, to secure eligibles from which to make certification to fill a vacancy in the position of engineer (competent to take care of pumping plant, tank house, etc.), $720 per annum, Indian Service, Fort Berthold, North Dakota, and vacancies as they may occur in the Indian Service.

A Norwegian market for spiral pipe is possible according to Consul Felix S. S. Johnson, who writes from Bergen that the waterfalls of the country are being gradually taken up, and their power in some instances is carried by means of pipes several miles. A proposition is now being considered by the city council to unite the streams in and around Bergen by means of tunnels and pipes, affording manufacturers and others electrical power.

Electricity passing through a whip killed Henry Holiman near San Jose, California. According to a newspaper report Holiman, together with the son of his employer, M. C. Vennum, were washing a wagon during a rainstorm. While they were standing with their hands on the wheels both experienced an electric shock and were hurled to the ground. Vennum was not seriously hurt, but Holiman did not regain consciousness and died within a few minutes.

Gas engines supplanting Dutch windmills. According to Consul-General S. Listoe of Rotterdam windmills are principally used in Holland for the purpose of pumping water out of drain ditches, which must be done regularly in order to keep the fields and meadows dry, the greater part of the Netherlands lying below the level of the sea. It is claimed that wind is too uncertain a motive power for the purpose mentioned, and hence gas motors are gradually being introduced.

The demand for gas in Tokyo is steadily increasing. The advance in the price of charcoal and firewood is rapidly forcing the public to avail themselves of gas for cooking purposes. It is expected that the rate of dividend to be distributed by the gas company for the present half year will exceed 10 per cent per annum. The increased demand for gas has necessitated the extension of the company's works and the payment of a further $6.25 on the new shares of the company will be shortly called up to provide funds for the extension.

The Tuilieres hydro-electric works, the largest of the kind in France, is nearly completed. It is 10 miles from Bergerac (Dordogne). The power will be 23,000 h. p. It is built on the River Dordogne, which has been dammed. The water drives nine 2,700 h. p. turbines. The hydraulic works is supplemented by a steam works with Curtis turbines and 6,000 kilowatts Thomson-Houston alternators. The current is supplied at 55,000 volts, and conveyed 62 miles to Bordeaux, 28 miles to Periguex and 74 miles to Aledin Angouleme.

The Michigan Central will electrify all the terminals at Detroit, and the main line as far west as Ypsilanti, thirty miles from Detroit. It is planned to abolish local trains and use large electric cars for local business, having the steam trains stop only at the large cities. Electric power will be generated by a waterpower plant to be built in the Huron River at Chelsea, Mich. The plans are said to contemplate the use of electric locomotives to draw trains from Ypsilanti into Detroit and through the tunnel now being built under the Detroit River.

The Niagara power treaty for the settlement of differences between the United States and Great Britain relating to Niagara Falls and the Great Lakes has been signed by Secretary Root and Ambassador Bryce. The treaty requires that the level of Lake Erie must be maintained, and permits Canada to use for power purposes at Niagara 36,000 cubic feet of water per second, and fixes the amount for the United States at 20,000 cubic feet, an increase of 1,500 cubic feet over the amount recommended by the International Waterways Commission to dispose of future problems that may arise in administering its provisions.

Water-power development in Tasmania, Australia, is confined to the city of Launceston, where for thirteen years a portion of the water power available in the South Esk River has been used by the municipality for the electric lighting of the city. The power station is 2 miles from the city, and the machinery comprises four three-phase generators and turbines of 150 horsepower each. In the city there are over 30 miles of streets lighted by electric lamps, and business places and private houses use the electric light largely. Electricity is also used for motors and heating appliances. The municipal council of Launceston has so far spent over $800,000 in constructive work. No state in Australia has such abundant water power as Tasmania, but as yet, however, there has been no systematic investigation, either by the government or by private persons, as to the cost of developing most of this power. The interior of Tasmania is mostly 1,500 to 2,000 feet above sea level. The moisture laden clouds from the northwest discharge most of their contents on the first highlands they meet. In the northwestern part of this plateau there are a number of great lakes, the four principal ones being Lake St. Clair, Lake Echo, Great Lake, and Lake Sorell. In the northwestern part of this lake country the rainfall is said to average 84 inches, but at the southeastern end only about 35 inches. Any successful power plant, therefore, would probably necessarily be located in the northwestern part of the lake region. It has been roughly estimated that from Lake St. Clair could be produced a minimum of 46,000 horsepower, from Lake Echo 9,000 horsepower and from Great Lakes 27,000 horsepower, a total of 82,000 actual horsepower. These three lakes are from 2,000 to over 3,000 feet above sea level, and it is said that as natural reservoirs they could, by comparatively small expenditure, store the abundance of rain falling in the wet season for use during the dry season.

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CONTENTS

Voltage Regulation

About four o'clock these dark afternoons our proof-reader turns on his electric light. At first it burns brilliantly, but at the end of half an hour it is reduced to a dull yellow glow that only seems to accentuate the darkness. Soon, however, it brightens with a dazzling brilliancy and gladdens his eyes, until suddenly it is again dark—the lamp has burned out. This little scene, with variations, is enacted daily all over the country. It is caused by poor voltage regulation. It makes dissatisfied customers, who may finally order their meter taken out, and it also means that the lighting company is losing money, for a lamp that is burning low is using much less current than one giving a normal light. For years it has been the operator's most important duty to keep the voltage steady. Now there are several devices on the market which do this work automatically. The question therefore arises as to how far this automatic regulation can proceed. The opinions of several engineers in Southern California on this question were brought out during the course of the discussion on a paper by Mr. J. A. Lighthipe, which we publish in this issue. Mr. Lighthipe is a veteran in this field, having been connected with the earliest lighting plants in the West "before the power factor was born." His reminiscenses of early days are interesting and suggestive. The concensus of opinion of those entering into the discussion seems to be that, while regulation is comparatively as far from perfection to-day as it was at the beginning of things, yet its great progress and success to date justifies hope for the near future. There is little likelihood, however, that we can ever dispense with "the tireless, sleepless, more or less reliable attendant, who must still at times come on the scene and save the day, as of yore."

Central Station and Railway Statistics

Through the courtesy of Mr. T. C. Martin, expert special agent for the Bureau of the Census, we are enabled to present preliminary statistics on the central stations and the electric railways of the United States for 1907, which are to be followed by similar data on the telephone and telegraph industries. These, together with the corresponding figures for 1902, appear on another page of this issue.

An examination of the central station report shows that the total investment, exclusive of isolated plants, was a billion dollars, nearly double what it was five years previous. In the same period the income has more than doubled, the output is two and one-third times greater, and the capacity of the hydro-electric generators nearly three times as great. To use this current the number of incandescent lamps

has been more than doubled, and the number of stationary motors nearly quadrupled.

Of electric railroads there are 34,404 miles, 5 per cent of which, by the way, are in California. The 83,641 cars carried nearly ten billion passengers of which nearly two billion rode on transfers. To run these cars and operate electric light plants in connection with them required 4,759,000,000 kilowatt hours. The gross income for the year 1907 was nearly $430,000,000, of which over $25,000,000 was paid in dividends.

The data shows that in five years' time these two industries have practically doubled in everything except dividends, which unfortunately have been low enough to satisfy the most exacting public service commission that the corporations are not all getting rich over night. The net income of the central stations would pay but 4 per cent on the investment, while that of the railways gave a 2½ per cent return on capital invested. These apparent figures should be a trifle higher, as interest on the bonds is figured as an expense.

ANNUAL DINNER AND SMOKER, LOS ANGELES SECTION A. I. E. E.

The largest gathering of Electrical men ever assembled in Los Angeles turned out to the dinner and smoker held on the nineteenth of January. One hundred and forty-two members and their friends accepted the invitation sent out by the local section of the American Institute of Electrical Engineers.

Mr. V. L. Benedict worthily filled the position of toastmaster, while Mr. H. C. Bowers officiated as Chaplain.

The toastmaster in his usual good natured style took a rap at everybody in sight and his victims were not far behind in their responses. It was necessary to appoint big Bill Smith as bouncer before the "Agony Quartette" composed of Messrs. Morris, Clapp, Green and Lewis, got through singing their parody rendition of "Bible Tales."

"BIBLE TALES.

Absalom he wore his hair quite too much pompadour,
Got mixed up with a tree and Abie cut his hair no more.
Manahan was right behind, a scootin' like the deuce,
He escaped for on his curl he used high potential juice.

Noah heard an awful row and cries for a square deal,
Said Tiger, "Here's an extra monk, I'd make a better meal."
But looking closer Noah found the monk was one of you,
But even if you offer thirty cents he won't tell who.

Ballard was the engineer of Noah's famous bark,
Put electric lights on her, some tungstens and an arc,
You have heard of mastodons; the reason they're extinct,
'Twas to make room for Arthur, they were pushed off in the drink.

There was a King in Bible times who had a funny way
Of shoving folks he didn't like in a furnace hot to stay,
Once he was taken by surprise when he shoved in a batch,
Lighthipe peeked outside the door and asked him for a match.

The usual placid countenance of City Electrician Manahan was transformed by the thirteenth verse which the quartette would insist on repeating. The bouncer managed to keep order while the quartette finished in triumph, although even the head-waiter said it was fierce.

Mr. A. S. Havens entertained those present with a remarkable sleight of hand performance with cards. So far as known none of the silverware or dishes disappeared.

Mr. W. J. Clark of New York, gave a very interesting talk on "Heavy Traction." Among the other speakers were Mr. C. W. Koiner, Chairman of the Local Section; Mr. Walter Fagan, Mr. R. H. Manahan, who also contributed a Chinese song, while Mr. B. A. Wagner whistled himself into the good graces of the audience.

The evening's entertainment concluded with an half hour's demonstration on high voltage, high frequency apparatus by Prof. H. LaV. Twining. A specially constructed "Oudin resonator" with the usual form of transformer and condenser used in wireless telegraphy, provided a very spectacular exhibition.

PERSONAL.

George A. Packard, metallurgist and mining engineer of Boston, was in San Francisco this week.

H. B. Vanzwoll, secretary of the Sunbeam Incandescent Lamp Company, Chicago, Ill., will make his annual trip to the Pacific Coast in March.

W. H. Bissell has resigned from the employ of the Great Western Power Company to become manager of the Livermore Water and Power Company, succeeding D. J. Murphy, of Livermore, resigned.

C. W. Scott, manager of the San Francisco office of H. W. Johns-Manville Company, is attending the regular convention of managers of his company in New York City, and will return about the middle of February.

H. C. Rice, vice-president of the General Incandescent Lamp Company, Cleveland, O., is planning a trip to the Pacific Coast for some time in March or April. It has been about 18 months since he favored this section with a visit and the many friends he made during his former visit will be unusually glad to see him again.

F. E. Wilson, who is associated with the Franklin Electric Company, manufacturers of the Femco Incandescent Lamp, of Hartford, Conn., is now in San Francisco and will spend some weeks upon the Pacific Coast in the joint interest of his company and the Holabird-Reynolds Electric Company, who represent them in this territory.

Edward C. Brown, manager of the Hawaiian office of the Dearborn Drug and Chemical Works, at 42 Queen Street, Honolulu, is making an extensive Oriental trip of three or four months, during which he will visit Japan, the important sea coast cities of China, Australia, the Philippines, Java, and other important islands in the Pacific Ocean.

H. S. Salt, well known in San Francisco through his connection in years past with the old California Electrical Works, and who has for the past two years been associated with the Dale Company of New York as manager, severed his connection with that company under date of January 1st, and has opened an office in New York City as manufacturers' representative. His many friends on the Pacific Coast join in wishing him success in his new undertaking.

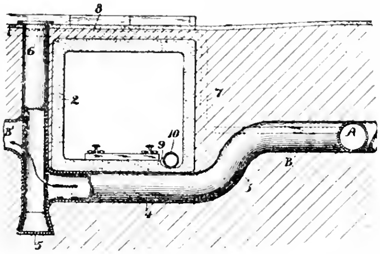
OBITUARY.

John J. Lewin, one of California's foremost electricians, died January 24 at his home near San Jose.

For ten years the decedent was electrician of Leland Stanford University, and at the time of his death was city electrician of Palo Alto. To him is credited the introduction of incandescent lighting in California. He was recognized as a man advanced in his profession, and at the time of the wedding of Miss Theresa Fair and Hermann Oelricns he was called upon to install all the elaborate lighting for that event.

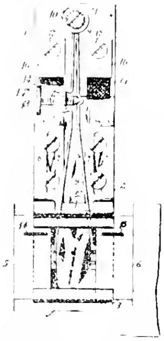
PATENTS

908,980. System for Conducting Water and Sewage Through Tunneled Streets. John J. Eagan, San Francisco, Cal. Filed Aug. 17, 1906. Serial No. 331,054. 1. A system for conducting water and sewage through tunneled streets consisting in combination with the tunnel having a longitudinal trough containing a pipe at one side of the base of said tunnel, a sewer pipe lying transversely in close proximity to said base



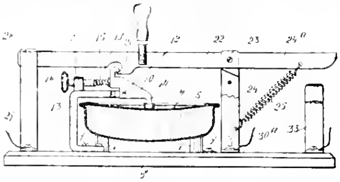
of the tunnel, said pipe curving upwardly at one end and thence extending laterally, a manhole at one end of said tunnel leading vertically from the sidewalk to said pipe, and a downwardly flaring basin for sediment at the base of said manhole, said basin extending below said pipe, and a pipe running transversely over said tunnel and thence continuing downward vertically in proximity to the other side of said tunnel and thence extending laterally to the main longitudinal sewer.

909,834. Brush-Holder for Dynamo-Electric Machines. Miles Walker, Hale, England, assignor to Westinghouse Electric & Manufacturing Company, East Pittsburg, Pa. A brush holder comprising a frame or base plate of conducting material having guide projections that produce a lateral recess,



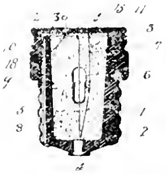
one of said projections being adjustably attached to the frame, brush blocks movably mounted in the recess and electrically connected to the frame, and a V-shaped spring secured to the frame and having resilient arms which engage the adjacent surfaces of the contact blocks.

909,818. Thermo-Electric Alarm. John E. Paul and James M. Stewart, Denver, Colo., assignors of one-third to Geo. W. Dolezal, Denver, Colo. In a thermo-electric alarm, the combination with two circuits, signalling devices located in the respective circuits, and a movable device arranged to make or break the said circuits alternately, of a sealed fluid container provided with a flexible diaphragm adapted to be actuated by the expansion or contraction of the fluid within the container, and a suitable connection between the said diaphragm and the movable circuit-closing part whereby when the diaphragm is in one position the said movable part is held



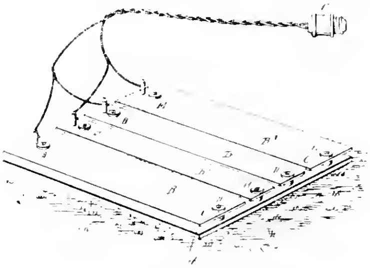
in position to close one circuit, while when the diaphragm is in the opposite position, the said movable part is caused to move into position to break one circuit and close the other circuit.

909,564. Electric Fuse. Louis W. Downes, Providence, R. I., assignor to D. & W. Fuse Co., Providence, R. I. In a plug fuse, a cup-like or hollow plug casing; a main fuse-wire inclosed by the casing, a cover closing the open end of the casing; indicating means including an auxiliary or indicator fuse-wire in parallel circuit, with the main fuse-wire, and



a small body of suitable combustible material associated with the cover and indicator wire and adapted upon fusing of said indicator wire to afford at the exterior of the cover a visual indication of the condition of the main fuse-wire; and an outer transparent suitably noncombustible covering applied to the cover over the indicating means.

909,814. Electric Trap for Rats. John T. Norris, Troy, N. C., assignor of one-half to Christopher C. Wade, Troy, N. C. An electric trap comprising an insulated base a series of conducting plates separated from each other and supported on



said base but insulated therefrom, and positive and negative wires adapted to be connected with a source of electrical energy and with alternate plates.

909,507. Prism for Electric Lamps. Justus C. Zubli, Seattle, Washington. An attachment for electric lamps comprising a reflector for engagement with the bulb of the lamp, a prism rotatably mounted in front of the lamp bulb, the mounting of the prism being carried by the reflector and means in connection with the mounting for permitting the prism to swing with respect to the lamp.

INDUSTRIAL

THE 110,000 VOLT TRANSMISSION LINE OF THE GRAND RAPIDS MUSKEGON POWER COMPANY.

Considerable interest has been aroused by the 110,000 volt transmission line of the Grand Rapids Power Company which, now that it has been operating satisfactorily for six months, has proved the entire practicability of this voltage for long

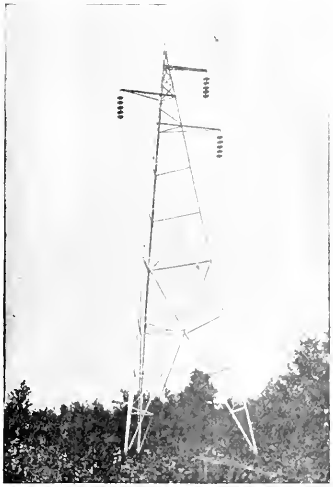


Fig. 1. Steel Tower With Suspension Insulators.

distance electric transmission of power, runs between Grand Rapids and the Croton dam, Michigan, and is fifty miles in length. The line is carried on triangular steel towers which are approximately 53 feet in height over all and 43 feet, 8 inches from the ground to the lowest cross arm, and which were de-

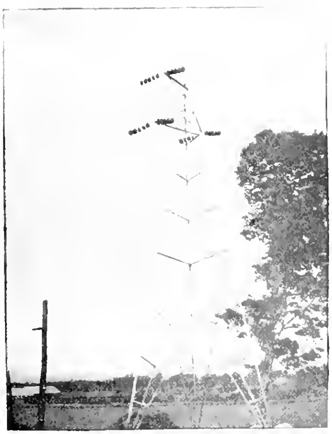


Fig. 2. Steel Tower with Strain Insulators.

signed to give a 40 foot clearance between the line wire and the ground. The towers weigh approximately 1,700 pounds each and provide a minimum spacing between the insulator hangers of 8 feet; they are placed on large concrete anchors buried in the ground and are spaced 528 feet apart on tangents, (Figs. 1 and 2) The anchors consist of 3 inch angle steel, 7 feet and 10 inches long, encased in concrete. The anchors each extend about ten inches below the bottom of the concrete in which

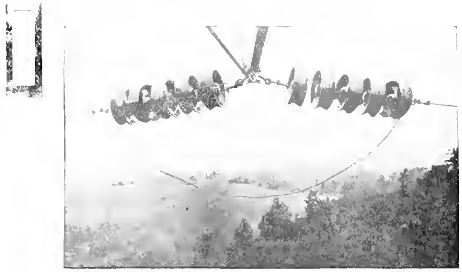


Fig. 3. Strain Type General Electric Disk Insulators.

they are encased, thus securing a ground for the transmission line.

In view of the many troubles experienced by the large majority of companies when first starting a high tension transmission

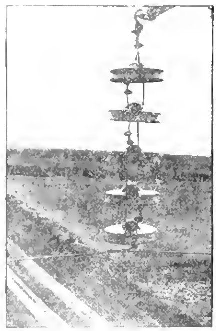


Fig. 4. Suspension Type General Electric Disk Insulator.

line using pin insulators, a report made on the operation of this line is of special interest. This report states that "this line has been in operation since July 18th last and we have experienced no trouble whatever. Nothing of an unusual nature

Fig. 5. Croton Dam Generating Station.

has occurred and we consider its operation as very satisfactory and successful."

The majority of the right of way is located along the highways, and only a tower right was taken. Where the line

passes through forests or makes short cuts across country, a strip of land was purchased, varying in width from 33 to 66 feet, according to circumstances. This land is usually fenced off. No protection whatever is used where the lines cross highways or traffic routes.

The insulators are of the standard General Electric disk pattern, the suspension type being used for a straight support and the strain type for pull-off curves. Five of these 10 inch disks

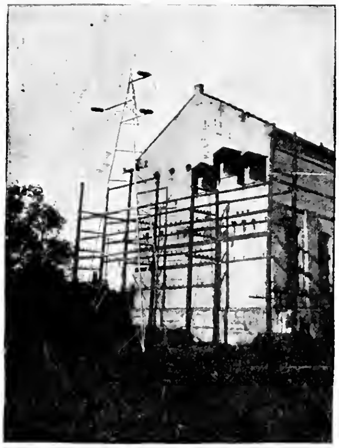


Fig. 6. Rear View of Croton Dam Generating Station.

are used in series, the arrangement being very clearly shown in Figs. 3 and 4. Each disk is rated at 25,000 volts.

The line transmits 10,000 k. w., the conductors consisting of No. 2 stranded hard drawn copper wire with hemp center. The lines are spaced 8 feet apart and are entirely without transposition throughout the whole length. No guard wire is used.

The lines are brought into the stations through porcelain insulators and are connected directly to the high tension transformers, which are delta connected on both sides. There are no

Fig. 7. Static Discharge From the Line.

switches of any kind in the lines, the control being by means of generator field switches.

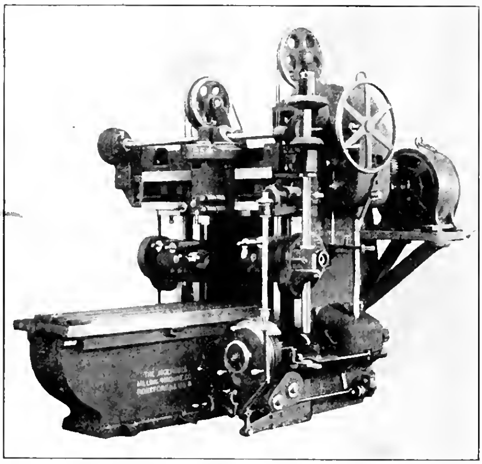
The pressure was first applied to the transmission line on July 18, 1908, and it was noticed that the line was a little noisy at the working pressure of 110,000 volts, while at night the atmospheric discharge was distinctly visible. Wattmeter ratings on the empty line, after deducting the core losses of the step up transformers, seemed to indicate a constant loss on the 50 miles of line of from 20 to 25 k. w.

Other interesting features of the line are shown in Figs. 5 to 7 inclusive.

A MOTOR DRIVEN THREE HEAD MILLING MACHINE.

The special operations involved in the manufacture of various products have led to the devising of new machines and the modification of existing machines to meet the new needs. The phenomenal growth of automobile manufacturing in recent years and the special parts to be machined have given rise to the production of the milling machine shown in the accompanying illustration.

The tool is designated by the manufacturers, the Ingersoll Milling Machine Company, as the Automobile Type Milling Machine, and is made particularly for milling engine bases and transmission cases of automobiles. It is, however, not only adapted for this work, but for any other work which may be machined on either a planer or milling machine. The three spindles have speeds varying from 15 to 120 r. p. m. The speeds are arranged for face mills up to 10 inches in diameter for steel or cast iron, but for aluminum work larger



Motor Driven Three Head Milling Machine.

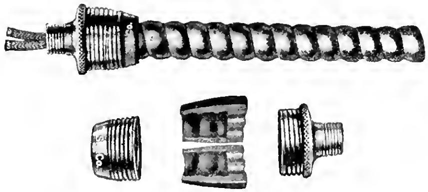
cutters may be used. The machine has a capacity of 26 inches between the ends of the horizontal spindles, and 24 inches between the table and vertical spindle.

The motor equipment consists of a 15-horse power, direct current, shunt wound, Westinghouse Type S motor. The motor is mounted on a bracket in the rear of the machine, where it takes up little space and does not interfere with the work or the operator. The speed changes, from 875 to 1,500 r. p. m., are effected by variations in the shunt field by means of a Westinghouse drum type controller, not shown in the cut. In addition to the range of speed thus obtained, there are four changes by mechanical means. This enables the cutting speed required by the work to be obtained with exactness and maintained with certainty. In the case of machine tools especially is it desirable to have a perfect control and adjustment of the speed; and undoubtedly the most satisfactory method of obtaining this is by means of the adjustable speed motor and a suitable controller.

Harvard Electric Company, Chicago, report that the new Harvard Patent Galvanized Channel Steel Bracket is meeting with success since it was placed on the market a few months ago. The firm has sent out a number of brackets on approval and has received orders and testimonials relative to its serviceable qualities. This line includes steel construction material for telephone, telegraph, electric light and power transmission work in the way of brackets, foot and corner S traps, pole fixtures, construction tools, etc. Mr. Allen L. Haase, for years actively identified with the Steel Bracket industry, is now sales manager of the Harvard Electric Company, 66 W. Van Buren Street, Chicago, and 136 Liberty Street, New York City.

NEW BRASS INSULATED BUSHING.

Complying with the National Board of Underwriters' rule that lamp sockets must be insulated from the armor of armored cord the Sprague Electric Company has developed a new brass insulated bushing. It consists of two brass parts and two composition insulating wedges as shown in the sectional view. The brass



parts of the bushing are insulated from the steel armor by two composition insulating wedges which grip the armor as the bushing is screwed into place. Thus these bushings provide thorough insulation between covers of boxes and sockets and the cord armor.

TRADE CATALOGUES.

The Terry Slow Speed Steam Turbine is illustrated and described in Bulletin No. 16 from the Ohmen Engine Works of San Francisco.

Bulletin No. 47 from the Eck Dynamo and Motor Co., is devoted to motor-generators and is arranged to be filed in their sectional catalogue and data book.

MacGovern, Archer & Co., 111 Liberty street, New York City, have issued a list of second hand electrical and steam apparatus which they have in stock.

Bulletin No. 19 for the H. Krantz Manufacturing Company, of Brooklyn, N. Y., is devoted to their Type H Knife Switches, single, double and four pole, single and double throw, back and front connection, fused and unfused.

Automatic High Speed Engines for direct connected work is the title of a handsomely printed and bound bulletin, No. 10, ssued by the Ohmen Engine Works, 17th and Capp streets, San Francisco. These engines are of the highest class, designed and built specially for high duty and continuous service, as is shown by illustrations of a large number of installations. This catalogue also contains valuable data on computing power, including a table of power ratings.

In Folder No. 3744 just issued by the General Electric Company is described the company's transformer for use in connection with moving picture machine arc lamps. The transformer is known as The G. E. Economy-Arc, and the advantages claimed for it are reduction of light bills, simplicity of operation and safety. The saving in power insured by the use of a transformer instead of a rheostat varies from 65 to 90 per cent, depending upon the voltage of the circuit.

Bulletin No. 4637, recently issued by the General Electric Company, illustrates and describes various styles and sizes of Tungsten Incandescent Lamps for Battery Service. The high efficiency of the Tungsten filament renders it especially suitable to the production of an ideal battery lamp where high efficiency is necessarily a prime requisite. The bulletin illustrates and describes battery lamps, novelty lamps, surgical lamps, lamps for limousine automobile lighting, and various other styles with miniature bases and bases adapted for use in standard sockets. The bulletin contains also prices of the various types.

TRADE NOTES.

The Holabird-Reynolds Electric Company of Los Angeles and San Francisco, have been appointed sales representatives for the Sachs Company of Hartford, Conn. They will carry a full line of non-arcing enclosed fuses and electrical protective devices.

SUNBEAM LAMP REMOVAL.

The Sunbeam Incandescent Lamp Company, Chicago, has moved its sales office and warehouse from 32 West Polk Street, to the Western Electric Company Building at 259 South Clinton Street, Chicago. This change was made as larger quarters were needed to properly take care of the increased volume of business handled by both the Sunbeam Company and the Western Electric Company since the adoption of the Sunbeam Tungsten lamp. The Sunbeam product is well and favorably known, having been on the market continuously for twenty years. They manufacture a complete line consisting of, in addition to regular lamps, Gem, Tantalum and Tungsten filament lamps of all styles, candlepowers and voltage. The entire output of the Sunbeam Incandescent Lamp Company is distributed through the Western Electric Company, Chicago or New York, and their various branch houses throughout the United States.

COAL BRIQUETS ON LOCOMOTIVES.

In co-operation with the Missouri Pacific, the Lake Shore and Michigan Southern, the Michigan Central, the Chicago, Rock Island and Pacific, the Chicago, Burlington and Quincy, and the Chicago and Eastern Illinois railroad, 100 locomotive tests have been made by the United States Geological Survey to determine the value, as a locomotive fuel, of briquets made from a large number of western coals. All tests were made on locomotives in actual service on the road. In some tests there was small opportunity for procuring elaborate data, but in others, where dynamometer cars were employed, it was possible to obtain more detailed results. The purpose which these tests were intended to serve was not so much to determine the evaporative efficiency of briquets as to investigate their behavior in practical use.

Briquets made from Arkansas semianthracite, two qualities of Indian Territory slack, Indian Territory screenings, Missouri slack, Indiana Brazil block slack, coke breeze, and a mixture of coke breeze and washed Illinois coal were tested, and comparisons were drawn either with the same coal that was used in the briquet or with coal similar to it. In nearly every test the results reported show that the coal when burned in the form of briquets gives a higher evaporative efficiency than when burned in the natural state.

For example, Indian Territory screenings give a boiler efficiency of 59 per cent, whereas briquets made from the same coal give an efficiency of 65 to 67 per cent. Decrease in smoke density, the elimination of objectionable cinders, and an apparent decrease in the quantity of cinders and sparks are named as the chief reasons for this increased efficiency.

The cost of briquetting, including all charges, is estimated to be about $1 per ton of briquets; that is, the briquetting added approximately $1 per ton to the cost of the coal. The briquets were made, however, in an experimental plant, and the price is for this reason probably not so low as if they had been made on a much larger scale.

The briquets were made by the fuel-testing plant of the United States Geological Survey at St. Louis. The coal was shipped from the mine at Lloydell under the supervision of an inspector of the survey, who at the same time obtained nine samples. The samples were hermetically sealed and sent to the St. Louis laboratories for analysis. After the coal was made up into briquets it was returned to the locomotive testing plant at Altoona, Pa., for the tests.

To observe the effects on briquets of exposure to the weather, a number of the round and square briquets were placed on the roof of the testing plant. After four months of exposure for the round and three months for the square briquets, no change whatever from their original condition was noticed. They appeared to be entirely impervious to moisture and were still firm and hard.

CENSUS REPORT ON CENTRAL STATIONS.

The statistics relate to the years ending December 31, 1907, and June 30, 1902. The totals include central stations only. They do not include isolated plants or plants that were idle or in course of construction, and in but few instances plants operated by electric railway companies.

	1907.	1902.	Per cent of increase.
Number of establishments	4,714	3,620	30.2
Commercial	3,462	2,805	23.4
Municipal	1,252	815	53.6
Total cost of plants	$996,613,622	$504,740,352	97.5
Total income (1)	$175,642,338	$85,700,605	104.9
Lighting service	$125,755,111	$70,138,147	79.3
All other electrical service	$43,859,577	$14,048,458	212.2
All other sources	$6,027,647	$1,514,000	298.1
Total expenses	$134,196,911	$68,081,375	97.1
Salaried employees			
Number	12,990	6,996	85.7
Salaries	$11,733,727	$5,663,580	107.2
Wage earners:			
Average number	31,612	23,330	18.5
Wages	$23,686,537	$14,983,112	58.1
Supplies, materials and fuel	$44,158,568	$22,915,932	94.0
All other expenses (including interest on bonds)	$54,318,019	$24,518,751	121.5
Steam and gas engines (including turbines):			
Number	7,674	6,095	25.9
Horse-power	2,681,228	1,392,122	92.8
Water wheels:			
Number	2,474	1,390	78.0
Horse-power	1,317,487	438,472	207.3
Total kw capacity of dynamos	2,642,403	1,218,735	116.8
Output of stations, total kw hrs.	5,858,121,860	2,507,051,115	133.7
Estimated number of lamps wired for service:			
Arc lamps (2)	555,924	385,698	44.1
Incandescent lamps (2)	41,807,944	18,194,044	129.8
Stationary motors served:			
Total horse-power capacity	1,649,026	438,005	276.5

(1) Exclusive of income for current used for light and power that was furnished by railway companies, and which is included in the report for street and electric railways.

(2) Exclusive of lamps used by the establishments reporting to light their own properties.

The final report will contain an analysis of the above totals and present detail statistics by States and for other phases of the industry.

CENSUS REPORT ON STREET ELECTRIC RAILWAYS.

The totals include reports of operating and lessor companies and a considerable number of electric light plants operated in connection with electric railways, but do not include reports of railways under construction during the census years; nor do they include reports of financing companies which were not engaged in actual operation of railways or light plants.

	1907.	1902.	per cent of increase.
Number of operating and lessor companies	1,236	987	25.2
Length of line (first main track), miles	25,547	16,652	53.4
Total length of single track, miles	34,404	22,577	52.4
Number of cars, total	83,641	66,784	25.2
Passenger	70,016	60,290	16.1
All other	13,625	6,494	109.8
Number of power houses	827	805	2.7
Steam and gas engines (inc turbines) number	2,552	2,351	8.5
Horsepower	2,381,518	1,300,058	83.1
Water wheels, number	228	160	42.5
Horse-power	91,961	49,303	86.5
Total kw. capacity of dynamos	1,727,030	898,362	92.2
Output of stations, total kw hrs.	4,759,130,100	2,261,484,397	110.4
Passengers carried, total	9,533,080,766	5,836,615,296	63.3
Fare	7,441,114,508	4,774,211,904	55.9
Transfer	1,995,658,101	1,062,403,392	87.8
Free	96,308,157	(1)	....
Total car mileage (passenger, express, freight, etc.)	1,618,343,584	1,144,430,166	44.4
Condensed income account, operating companies:			
Earnings from operation	$418,187,858	$247,553,999	68.9
Income from other sources (2)	$11,556,396	$2,950,628	291.7
Gross income	$429,744,254	$250,504,627	71.6
Operating expenses	$251,309,252	$142,312,597	76.6
Net earnings (earnings less operating expenses)	$166,878,606	$105,241,102	58.6
Gross income less operating expenses	$178,435,002	$108,192,030	64.9
Deductions from income (taxes and fixed charges)	$138,094,716	$77,595,053	78.0
Net income	$40,340,286	$30,596,977	31.8
Dividends (operating companies only)	$25,558,857	$15,882,110	60.9
Surplus	$14,781,429	$14,714,867	0.5
Capitalization operating and lessor companies:			
Capital stock authorized par value	$2,508,054,336	$1,529,199,589	64.0
Capital stock outstanding par value	$2,097,708,856	$1,315,572,960	59.5
Dividends on stock	$73,589,399	$45,039,171	62.2
Bonds authorized par value	$2,319,320,837	$1,341,499,737	72.9
Bonds outstanding par value	$1,677,063,240	$992,709,139	68.9
Interest on bonds	$71,468,788	$43,578,961	64.0
Total par value stock and bonds outstanding (3)	$3,774,772,096	$2,308,282,099	63.5
Employees and wages, operating companies:			
Salaried employees, number	11,700	7,128	64.1
Salaries	$12,909,466	$7,439,716	73.5
Wage-earners, average Number	209,729	133,641	56.9
Wages	$138,081,633	$80,770,449	71.0

(1) Not reported separately.

(2) Includes $3,255,618 income from interest on bonds and dividends on stock of other electric railways.

(3) Includes permanent and other investments, such as securities of other electric railways, treasury stocks and bonds, gas plants, etc.: 1907—$388,394,092. 1902—$152,513,997.

The final report for 1907 will contain an analysis of the above totals and present detail statistics for other phases of the industry.

ELECTRIC RAILWAYS IN CALIFORNIA.

Compiled by the Journal of Electricity, Power and Gas.

Company.	Mileage.	Connects.
Bakersfield & Kern Elec. Ry. Co.	7.5 miles	Bakersfield and Kern.
Northern Electric Ry. Co.	131 "	Barber, Chico, Marysville, Oroville and Sacramento.
San Diego Electric Ry Co.	34 "	San Diego.
Coronado Railway Co.	2.09 "	San Diego and Coronado.
National City & Otay Ry. Co.	28 "	San Diego, National City and Chula Vista.
Los Angeles & San Diego Ry. Co.	17 "	San Diego, La Jolla, Pacific Beach and Old Town.
South Park & Eastside Ry. Co.	2.5 "	San Diego.
Humboldt Transit Co.	13 "	Eureka.
Fresno Traction Co.	15.5 "	Fresno.
Nevada County Traction Co.	5 "	Grass Valley and Nevada City.
Los Angeles Ry. Co.	131 "	Los Angeles.
Los Angeles Interurban Ry. Co.	67 "	Los Angeles.
Pacific Electric Ry.	215.5 "	Los Angeles and Suburbs.
Los Angeles Pacific Co.	210 "	Los Angeles and Suburbs.
Monterey & Pacific Grove Ry. Co.	6 "	Monterey and Suburbs.
Vallejo, Benecia & Napa Valley Ry. Co.	16 "	Vallejo and Napa.
San Francisco, Vallejo & Napa Valley Ry. Co.	19 "	Napa and St. Helena.
Oakland Traction Co.	162.26 "	Alameda Co. Towns.
S. F., Oakland & San Jose Co.'s Ry.	18.68 "	Alameda Co. Towns.
Ontario & San Antonio Heights Elec. Ry. Co.	10 "	Ontario.
Santa Clara Inter-urban Ry. Co.	10 "	Palo Alto.
Petaluma & Santa Rosa Ry. Co.	36 "	Petaluma, Santa Rosa Sebastapool and Forestville.
Riverside & Arlington Ry. Co.	12.71 "	Riverside and Arlington.
Crescent City Ry. Co.	5 "	Riverside and Crestmore.
Sacramento Elec. Ry. & Gas Co.	28 "	Sacramento.
San Bernardino Valley Traction Co.	42 "	San Bernardino, Colton, Highland, Patton, Arrowhead and Redlands.
Northwestern Pacific Ry Co.	16.02 "	Sausilito, Larkspur, Mill Valley, Ross, Fairfax, and San Rafael.
Ocean Shore Railroad Co.	4 "	San Francisco.
Parkside Transit Co.	6.75 "	San Francisco.
Presidio & Ferries Railroad Co	7.63 "	San Francisco.
United Railroads of San Francisco	259 "	San Francisco.
San Jose Ry. Co.	15 "	San Jose.
San Jose & Santa Clara Co. Ry. Co.	28 "	Santa Clara, San Jose, East San Jose, Alum Rock Park.
San Jose & Los Gatos Interurban Ry. Co.	40 "	San Jose, Campbell, Los Gatos and Saratoga.
Pacific Coast Ry. Co	14 "	Santa Maria, Guadalupe and Betteravia.
Santa Barbara Consolidated Ry. Co.	10 "	Santa Barbara.
Union Traction Co.	15 "	Santa Cruz and Capitola.
Central California Traction Co.	29 "	Lodi and Stockton.
Stockton Railroad Co	13 "	Stockton.
Visalia Railroad Co.	21 "	Visalia, Exeter and Lemon Cove.

NEWS NOTES

FINANCIAL.

SAN FRANCISCO, CAL.—The Northern California Power Company, Consolidated, has declared a dividend of 10 cents per share, payable January 22.

WILLOWS, CAL.—The Northern California Power Company has appealed from the decision of the Superior Court awarding Mrs. May Diller, of Chico, $30,000 damages for the death of her husband.

SUNNYVALE, CAL.—At the annual meeting of the stockholders of the Sunnyvale Water Company, the reports showed that the company had assets of $14,000. The following officers were elected for the ensuing year: W. E. Crossman, president; R. Muender, vice-president; F. B. Hughes, secretary and treasurer. The new board of directors includes: C. L. Stowell, W. E. Crossman, J. F. Spaulding, R. Muender and C. C. Spaulding.

SAN BERNARDINO, CAL. A. G. Hubbard of Redlands, acting for the Cleveland Savings Bank and Trust Company, has deeded to the Bear Valley Mutual Water Company all of the water rights and other properties of the old Bear Valley Water Company for $1,234,533, and in return has received from the Bear Valley Mutual Water Company a trust deed covering all of this property to secure the payment of bonds to the amount of $900,000. This, it is believed finally adjusts the Bear Valley water rights questions, and places with the actual water users the irrigation project which included the construction of the Bear Valley dam many years ago.

INCORPORATIONS.

HANFORD, CAL.—Lake Oil Co., with a capital stock of $75,000, has been incorporated here by H. J. Light, C. H. Bailey, R. A. Moore, G. E. Chinn, and W. L. Scally.

SAN FRANCISCO, CAL.—Santa Rita Oil Co., with a capital stock of $100,000, has been incorporated in this city by H. H. Hart, J. C. R. Rudolph, J. H. Lewis, E. L. Firster and R. R. Moody.

SAN FRANCISCO, CAL.—Coalinga Star Oil Company, with a capital stock of $1,000,000 has been incorporated by C. S. Reynolds, P. Righetti, J. M. Byrne, John McMullen and J. H. Barnard.

MERCED, CAL.—The Dos Palos Telephone Company filed articles of incorporation last week. H. T. Reynolds, A. S. Woodhouse, and George Christien with 30 other persons are listed as shareholders.

SAN FRANCISCO, CAL. The Clear Lake Northern Railway Company with a capital stock of $1,000,000, has been incorporated in this city by R. C. Burnett, R. M. Sims, Marion Vecki, W. I. Brobeck and E. Schwab.

SAN FRANCISCO, CAL.—The Oakland and Antioch Railway Company has been incorporated here with a capital stock of $2,000,000 by A. W. Maltby, S. L. Naphthaly, Walter Arnstein, F. W. Brooks, H. A. Mitchell, and Allan Pollak.

TRANSMISSION.

SANTA CRUZ, CAL. Work has been begun on the excavation for the new electric power plant to be erected by the San Vincent Lumber Company at Moore's Gulch.

SAN FRANCISCO, CAL.— The Great Western Power Company has awarded a contract for 300 tons of steel to the American Bridge Company for a building in Oakland.

MAGALIA, CAL.—The power house of the Steifer mine was completely demolished by the rush of water after the dams above here collapsed last week. Only a part of the machinery now remains. The site will be immediately cleared and the plant restored.

RENO, NEV.—Rolla H. Clapp has appropriated 4,000 second feet from the Truckee River to be used for power purposes.

OAKLAND, CAL.—The San Francisco representatives of the Great Western Power Company have applied for a permit to construct a distributing plant on Sessions Basin. The building will be a reinforced concrete, fire proof structure and will cost $50,000.

CHICO, CAL.—At a meeting of the directors and stockholders of the Sierra Electric Power Company, held last week, the reports showed that poles have been cut, roads built, a telephone line constructed, canals dug and estimates and surveys made. Estimates on machinery are now being received. It is planned at first to develop 2,000 horse power and eventually to increase this to 6,000 horse power.

WALLACE, IDAHO.—Seven large dams will be constructed in the St. Joe river during the next two years by the Milwaukee, which, when completed, will be used to generate electric power that will run its trains through the mountain country. A company capitalized at $500,000 and known as the Idaho Water and Electric Power Company has been organized for the purpose. Plans have been drawn and all estimates made for the dams and active work will be started as soon as weather conditions will permit. The total cost of building these dams is estimated at about $300,0000 to $400,000.

DUNSMUIR, CAL. — The Siskiyou Electric Light and Power Company will extend its line from Montague to Dunsmuir, and install another 1,500 horsepower generator at Fall Creek. The equipment has already been ordered for the installation. The company expects to have the extension completed by June 1. Seven miles of the new power line is being installed along the Klamath River for the mines of that section. The company is now supplying power for light to Ashland, Oregon, and to Yreka, Montague, Aetna, Fort Jones, Klamathon, Lairds, Greenview, and Dunsmuir, in Northern California. The new extension will serve Gazelle, Edgewood, Weed, Sisson and Shasta Springs. The Siskiyou Electric Light and Power Company was recently re-incorporated for $1,000,000. Alex. J. Rosborough, of Oakland, is secretary.

TELEPHONE AND TELEGRAPH.

INDEPENDENCE, CAL.—A. T. Smith & Co. have been granted a telephone franchise in this county.

PLACERVILLE, CAL.—The petition of J. A. Fossati for the right to construct a telephone line along the old emigrant road has been filed.

CHICO, CAL.—The right to construct and operate a telephone line along a public highway of this county has been granted to J. H. Richardson.

LINCOLN, CAL. — The Farmer's Telephone Company west of Lincoln, has been granted permission to erect poles within the town limits for the construction of a line to the central office.

DIAMOND SPRINGS, CAL. The Diamond Springs and Hawks Exchange Telephone Company has elected the following officers: W. W. Hoyt, chairman and W. S. Voss, secretary. W. W. Hoyt was chosen general manager of construction.

PORTLAND, ORE.—The Postal Telegraph Company has been awarded $66,600 damages against the Southern Pacific Company in its fight to compel the railroad company to give it a right of way along its tracks between Portland and California.

ILLUMINATING.

PETALUMA, CAL.—The charter of this City is to be amended to allow it to acquire a municipal gas plant.

ARTESIA, N. M.—A franchise has been granted to Oscar B. Coates to erect an electric light plant in this city.

SANTA ROSA, CAL.—The Board of Supervisors has sanctioned the purchase of a gas generating plant for the County Hospital at a cost not to exceed $450.

FAIRFIELD, CAL.—A franchise was granted last week to the Nixon-Kimmel Company to erect and operate an electric transmission system for heat, light and power purposes.

BAKERSFIELD, CAL.—The directors of the Kern Power, Transit and Light Company are considering plans for changing the power house and doubling the capacity of the plant.

NAPA, CAL.—A franchise was sold last week to H. D. N. Lehe, of Dixon, to construct and operate a single pole electric light and power line from this city to the Lake County border.

GRIDLEY, CAL.—A contract for the construction of a municipal pumping and lighting plant has been given to Richard Jenkins. The building will be 50 x 30 feet in size, brick, with steel roof, fire proof, and will cost $2,027.

WOODLAND, CAL.—Because of a terrific wind and rain storm, last week, the electric light and power line was out of commission for three hours and communication with the outside world was cut off for the same length of time.

NORTH YAKIMA, WASH.—It is reported that Norman Brothers, owners of the Hotel Yakima and hotels in other cities, will erect a large power plant in this city for the purpose of generating power for heat and lighting purposes.

RENO, NEV.—Because of high water and land slides the several power plants that supply Reno, Carson and Virginia City with electric lights and power have all been out of commission, leaving those cities in darkness. All plants depending on electric power are closed.

LOS ANGELES, CAL.—The Edison Electric Company will spend half a million dollars in enlarging its gas plants in the towns surrounding Los Angeles. E. C. Jones of San Francisco, one of the foremost gas experts on the Coast, is now engaged in examining the works to ascertain their needs.

TACOMA, WASH.—It is proposed by the city council to build a steam power plant for use until the Nisqually river plant is completed and as an emergency plant afterward. The cost will be from $150,000 to $250,000, and voters will probably be called on to sanction the issuance of bonds at the spring election.

OIL.

BAKERSFIELD, CAL.—Ben A. Hayden has obtained the lease on the property of the Pioneer Oil Company in the Midway. He expects to begin drilling in 60 days.

VALLEJO, CAL.—The report is that the Standard Oil Company will establish a big refinery on the water front from which to supply the Napa Valley and Santa Rosa trade.

SAN LUIS OBISPO, CAL.—E. H. Smith and another interested partner, Mr. Grant, state that work on the construction of the plant of the California Petroleum Asphalt Company will begin soon and will be pushed as rapidly as possible.

SAN FRANCISCO, CAL.—The resignation is announced of John Baker, Jr., as second vice-president and general manager of the Union Oil Company. Donzel Stoney, a San Francisco attorney, is acting in Mr. Baker's place, and it is understood he will be formally elected next month.

LOS ANGELES, CAL.—The Canadian Pacific Oil Company is engaged in cleaning out its well No. 6, which became non-productive through clogging, and will soon have it in operation. They plan to sink a casing to the lowest stratum and materially increase the output of the company.

BAKERSFIELD, CAL.—Clarence J. Berry and Frank Keller may combine all their interests, including the C. and J. Oil and Gold Company in McKittrick, under the name of the C. and J. Oil and Gold Company. Other properties that will be included are the hydraulic mining plant installed in Alaska during the summer and more than 1,500 acres of proven lands in different fields of the State.

TRANSPORTATION.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has asked for an extension of time for the completion of its lines in this City.

SPOKANE, WASH.—The Spokane and Inland Railroad have ordered nine 72-ton locomotives and a number of freight and passenger cars in the East. In addition, they are in the market for road material.

FRESNO, CAL.—The Supervisors have granted to the Fresno Traction Company a franchise for the extension of its Forthcamp line to the Wilson and North Fresno tracts. General Manager Wilson said he expected to have the line in operation by March 1st.

CHICO, CAL.—As a result of the storm the Northern Electric Company's Hamilton branch from here has received heavy damage, the tracks being washed out for several miles. The total damage to bridges and public works in Butte County will not be less than $250,000.

WATERWORKS.

HONOLULU.—Superintendent of the Public Works Marston Campbell has been taking up the question of a better water system for Hilo, with William Vanatta, the superintendent of the water system.

LOS ANGELES, CAL.—The Board of Public Works has asked for sealed bids for 60,000 feet of ½-inch galvanized iron water pipe with alternative bids to furnish the same in wrought iron galvanized pipe.

HONOLULU.—Hugh Howell, county engineer of Maui, has submitted his report showing that the preliminary surveys for the new pipe line, as suggested by Assistant Superintendent Kluegal, have been completed.

LOS ANGELES, CAL.—The Board of Public Works has announced that it will receive sealed bids for furnishing materials and supplies consisting of 1-inch and 2-inch black iron screw pipe in accordance with specifications.

MONROVIA, CAL.—It has been decided to replace the boilers at Chapman wells plant with tubular 125-horse power boilers of the type used by the government. Other improvements will include a new style air lift and compressor.

SANTA CRUZ, CAL.—C. B. Byrne estimates that it will take 2,200 feet of 8-foot pipe, 7,200 feet of 6-foot pipe, 17,775 feet of 4-foot pipe, and a total of 25,175 feet of water pipe needed for the East Side and for a portion of the West Side.

OAKLAND, CAL.—The Board of Public Works has recommended to the City Council an ordinance appropriating the necessary money for the building and machinery for a high pressure salt water fire system, contracts for which will be let about June 1st, so that the plant can be completed and placed in commission at the beginning of the next fiscal year.

LOS ANGELES, CAL.—The Long Beach Water Company announces that improvements to the extent of $25,000 will be made. Cast iron mains will be installed to take the place of wooden pipes now used. A large storage reservoir and electric pumping plant will be constructed, and pumping plants on the north side of Signal Hill will be re-adjusted. The Company will also build a storage reservoir on the old dam site north of the high pressure reservoir.

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JOURNAL OF ELECTRICITY
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Devoted to the Conversion, Transmission and Distribution of Energy

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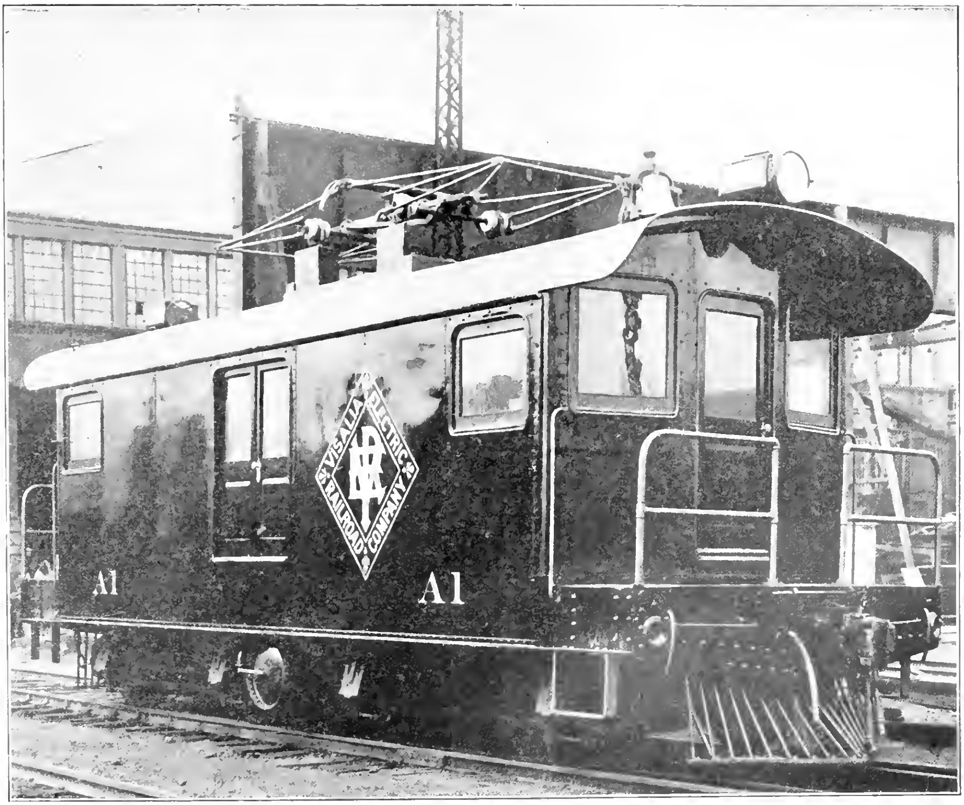
PERFORMANCE CHARACTERISTICS OF RAILWAY MOTORS.[1]

By A. A. MILLER

The subject matter of this paper deals with characteristic curves of the two prominent types of railway motors now used in the United States, i. e., 500 volt, direct current, series motors of the non-interpole form, and 25 cycle, single phase, series wound motors with compensating field winding. The development of the single phase motor in America and its use has been sharply contested by its sturdy predecessor and persistent rival, the straight series direct current motor. The effect of the newcomer has been to cause increased effort to preserve the field as far as possible for the older type, and the development of the interpole direct current motor for railway use has practically all been made since the single phase motor was placed on the market. The result has been a very greatly improved direct current motor, principally in commutation, reducing brush and commutator wear

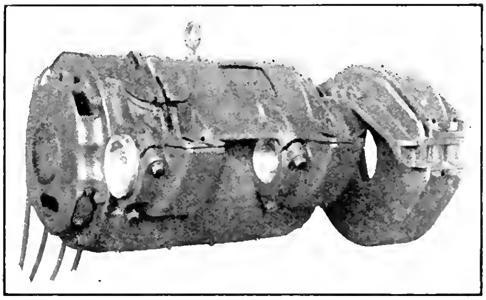


Typical Single Phase Electric Locomotive.

[1]Paper read before Seattle Section American Institute of Electrical Engineers, October 17, 1908.

by the elimination of nearly if not all sparking, even under the most severe operating conditions. The introduction of the commutating pole has made possible the grouping of two 600 volt motors in series across a potential of 1200 volts, thereby doubling the radius of operation with a given line drop. In this manner an attempt has been made to close the gap existing between the practical operating voltages of the direct current and single phase systems, but the attempt falls far short of accomplishing its entire object.

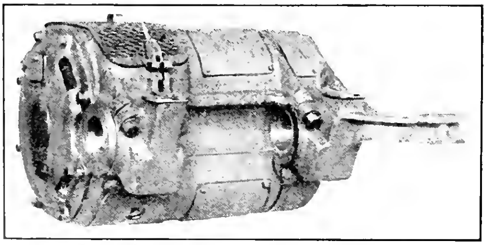
A comparison is made by means of the curves submitted herewith, between a 75 h. p., 500 volt direct current motor and a 75 h. p., 25 cycle, 220 volt single phase motor; also between a 90 h. p., 550 volt direct current motor and a 100 h. p., 245 volt single phase motor.



Direct Current Railway Motor With Gear Case.

It is interesting to note that the power factor is very nearly the same for a given armature speed regardless of the voltage at which the motor is operated. For example: when operating at 160 volts and such a load as to result in an armature speed of 600 r. p. m., the power factor is approximately 84%. When opererating at 200 volts and at a load enough heavier to hold the armature speed at 600 r. p. m., the power factor is approximately 83.5%. When operating at 245 volts and 600 r. p. m., the power factor is 83%.

Curves number 1 and 2 respectively represent the performance of the same car when equipped with four 90 h. p. direct current, 550 volt motors, and also when equipped with four 100 h. p. single phase, 245 volt motors; these curves show the performance for runs of one, three and five miles. It is seen that



Alternating Current Railway Motor.

the total weight of the car and single phase equipment is 46.4 tons and 41.1 tons with the direct current equipment. This weight is divided as follows:

	D. C.	A. C.
Car body	32000	32000
Trucks	23000	23000
Electrical Equipment	19410	29855
Brake Equipment	1800	2000
Passengers	6000	6000
Total	82210	92855

The equipment is divided as follows:

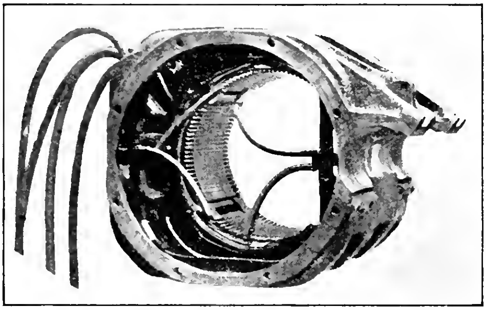
	D. C.	A. C.
Motors	17200	21760
Control apparatus and wiring	2210	2615
Transformer		5450
	19410	29855

The weight of the single phase electrical equipment is therefore, in this particular instance, a little over 50% heavier than the direct current equipment with which it is compared, a disparity existing in the aggregate nominal capacity, which is 400 h. p. for the single phase and 360 h. p. for the direct current.

On the basis of both aggregating the same nominal horsepower, the percentage difference in weight would be proportionately reduced.

The total weight of the entire car, equipment and passengers is about 13% heavier with the single phase motors than with the direct current motors.

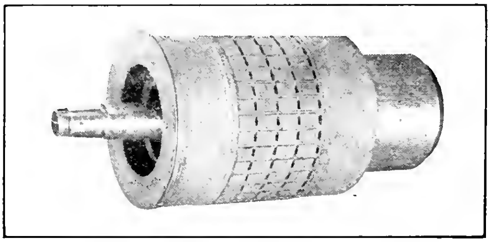
In comparing the typical run curves number 1 and 2, it should be noted that the motors were geared for a maximum speed on level track of 49 miles per hour, in each case at normal voltage.



Field of A. C. Railway Motor.

The car was started with an acceleration of .75 miles per second and stopped at the rate of 1.5 miles per hour per second. A stop of 15 seconds was assumed for each run. The curves were laid out to give a schedule speed of 24, 36 and 40 miles per hour in each case. A previously plotted curve was used for train resistance, the values given there having been found from actual experience to be very reliable and if anything to be high rather than low.

The results of the typical run curves are given in each case on the curve sheet, but may be summarized here as follows:



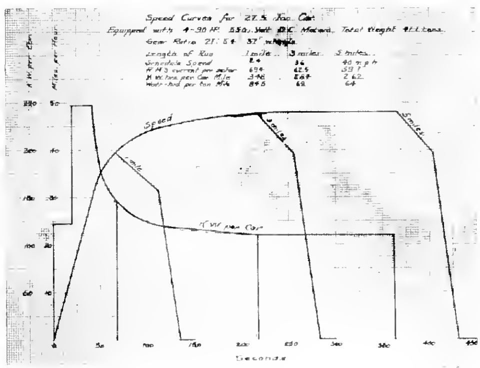
Armature of A. C. Railway Motor.

Description	1 Mile Run	3 Miles	5 Miles
Schedule speed A. C.	24	36	40
Schedule speed D. C.	24	36	40
Kw. hours per car mile A. C.	3.55	3.13	2.95
Kw. hours per car mile D. C.	3.48	2.84	2.63
Watt hours per ton mile A. C.	75.5	66.7	62.8
Watt hours per ton mile D. C.	84.5	69.0	64.0
Average power factor	80.7	88.3	90.5

The above for the single phase car includes the entire power; i. e., all car, transformer and motor losses. The increase in power taken by the single phase equipment is less than the increase in weight of the one car over the other, and on a basis of ton miles, the single phase motors are the more economical.

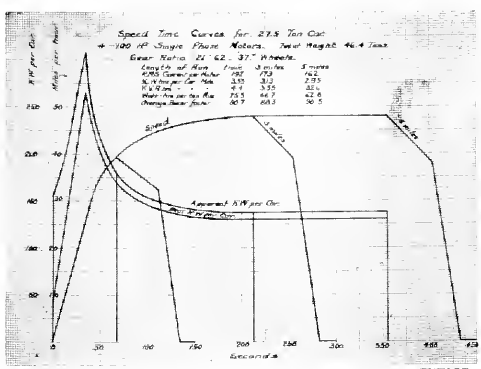
This, however, is not a proper comparison of the two from a commercial standpoint since the car itself and the paying load is the same in each case and the equipment should, therefore, really be compared on the car mile basis. Even on this basis the difference in power is very slight and is much more than compensated for by the increased economy of other parts of the system.

Similar curves were made for comparison between a car equipped with four 75 h. p. direct current motors, total weight 33 tons, and a car similarly equipped with the same size of single phase motors, total weight 37.75 tons.



Curve 1.

The over weight in this case is a little over 14% of the weight of the direct current outfit. From these two run curves the train performance curves were plotted showing the schedule speed and power consumption for runs of any length within certain limits. In preparing these curves no attempt was made to gear the motors for exactly the same speed or to make exactly the same schedule. The motors were geared for approximately the same speed and in both instances the rule adopted was that the car should coast an amount of time in seconds equal



Curve 2.

to eight tenths of the speed in miles per hour at which power was cut off. Also the length of stop was 15 seconds throughout.

From these curves the following data is secured, arranged for direct comparison.

Length of Run	Schedule Speed D. C.	Schedule Speed A. C.	Kw. Hours per Car Mile D. C.	Kw. Hours per Car Mile A. C.	Average Power Factor
0.5	18.3	19.2	3.53	3.43	80.1
1.0	25.0	25.5	2.85	3.21	86.2
2.0	31.5	32.8	2.35	2.92	90.6
3.0	34.75	36.3	2.18	2.83	92.2
4.0	36.4	38.3	2.08	2.8	93.0
5.0	37.5	39.8	2.02	2.77	93.5

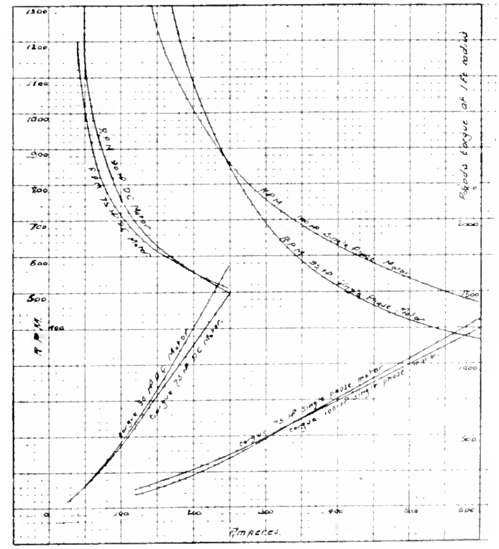
In considering these figures it must be borne in mind that the schedule speed of the single phase car is higher than that of the direct current, which accounts for part of the higher power consumption of the single phase apparatus.

As the gear ratios and wheel diameters are different, a direct comparison of tractive effort per ampere or kilowatt cannot be made without reducing to some common basis; i. e., either by making the gear ratios all alike and using the same size of wheels, then plotting the corresponding values of tractive effort or the performance of all motors can be reduced to pounds torque at one foot radius (at the armature shaft) and speed expressed in revolutions per minute of the armature. The formulae involved are as follows, since in the present case we must use formula instead of presenting the curves giving this fundamental data which are always plotted from test data, gear ratios, wheel diameters, etc., being applied thereto later to fulfill specific conditions:

Pounds torque = Tractive effort x wheel diam. x No. pinion teeth
at 1 ft. radius   Gear efficiency x 24 x No. of gear teeth.

and

Revolutions per =Miles per hour
minute (armature) Gear ratio x wheel diameter x .00297.



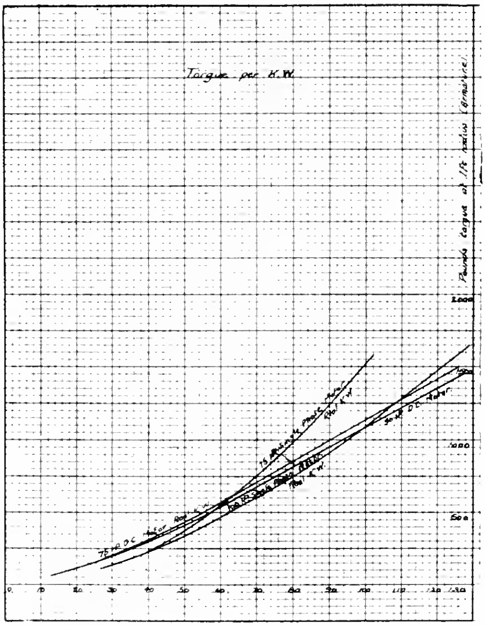
Curve 3.

Curve number 3 is thus obtained, which shows a material difference in torque per ampere and speed for the two types of motors. Torque per ampere, however, means little, and although the curves may seem unfavorable to the single phase motor as a type, the amperes in the trolley conducting system are the crux of the situation as it is well known that at the working potentials most frequently appearing in this country; i. e., the 3300, 6600 and 11000 volts, the trolley amperes are relatively few even for considerable power transmitted. This torque per motor ampere argument, therefore, cannot logically be used as a good one

against the single phase motor, since good commutation is obtained in both types of motors. The real basis of comparison, therefore, reduces itself to actual power used by the equipment to produce a given torque.

A fairly good idea of matters is obtained from curve number 4, which shows a decided similarity of performance for all motors directly covered by this paper.

Experimenters, designers and manufacturers should be congratulated for the remarkable progress made in railway apparatus during the last decade—progress made chiefly in the direction of utilizing higher voltages than has heretofore been possible. It is safe to predict that, for at least some years to come, commutator motors even of the interpole type will not be used for potentials of more than 1200 volts per motor, which binds the direct current system within narrow limits as compared to the alternating current system, with its flexibility of transformation to any desired voltage. The single phase motor has come to stay and is now enjoying the benefit of numerous successful applications, from which position of prestige it will not be dislodged by any competing alternating current systems. The three-phase system has not been tried sufficiently in this country to prove itself to be thoroughly adaptable to American use. An interesting installation of considerable magnitude is being carried out near at home; i. e., the electrification of the Cascade tunnel of the Great Northern Railway. This is being watched carefully by engineers interested in the great problem of handling long and heavy freight trains over a mountainous division of a very busy single track road.



Curve 4.

The single phase system as a whole has furthermore passed entirely beyond the development stage and it is now a matter of experience to start up a single phase road with as little trouble and as few interruptions as could be expected from a direct current installation of similar character.

Furthermore, a majority of the roads using single phase apparatus are making money, and if a close investigation were made of gross operating expense of those roads which are not paying, it would be found that it is not due to a high operating expense of single phase equipment, but to the fact that these roads have not yet been able to develop a sufficient traffic.

Coming down to definite figures, itemized records of operating costs are showing most satisfactory results, especially in view of the comparative newness of the system. It is true that the cost of maintenance is higher than for 600 volt direct current equipment, but this is not proving at all excessive. On one important system the maintenance cost averages 1.05 cents per car mile, whereas the cost of an equivalent direct current system is .78 cents per car mile.

On another line, 2.5 cents per car mile covers the total cost of maintenance including repairs and substation operators, maintenance on overhead work, cars, trucks, equipment inspection and cleaning. This would not allow more than one cent per car mile for the maintenance of the equipment. The increased cost of maintaining a direct current overhead line and substations would easily wipe out this difference in the cost of maintaining the car equipments. Right here it is pertinent to state that the cost of maintaining a 1200 volt direct current equipment would certainly be higher than the cost pertaining to a 600 volt system.

An average condition existing in the distribution of operating costs is that the maintenance cost of a car equipment is about one-fifth of the cost of the power used by that equipment, and this power item is very materially reduced in the single phase system as a whole.

On one of the roads above cited, line tests show that 101 watt hours per ton mile are required at the frequency changing station for approximately 89 watt hours at the car, or an efficiency of line transmission of 89%.

In a paper read by A. S. Richey before the Indiana Electric Railway Association in January, 1905, the average efficiency of the direct current system as determined from data collected from 85% of all the interurban roads in Indiana shows the following:

Step up transformers. . 94 per cent	Total 54.26 per cent
Transmission lines. . . . 97 per cent	
Step down transf'm's. . 93 per cent	
Rotary converters. . . . 80 per cent	
D. C. distribution. . . . 80 per cent	

Mr. Richey also found that the average at the power house was 5.12 kilowatt hours per car mile, which was for cars of an average weight of 30 tons operating under a moderate schedule. On one of the single phase lines (1.05 cents per car mile maintenance) there is an average power consumption of 4.29 kilowatt hours per car mile at the power house, while the direct current line having a car mile maintenance charge of .78 cents has a power consumption of 5.5 kilowatt hours per car mile. Furthermore, this road is operated from a third rail and the line drop is, therefore, less than usually obtained with overhead trolley.

The following efficiencies apply to the single phase system:

Step up transformers. . 94 per cent	Total 75.37 per cent
Transmission lines. . . . 97 per cent	
Step down transf'm's. . 93 per cent	
A. C. distribution. . . . 89 per cent	

This brings the matter of efficiency down to the point of consumption; i. e., the car. The 4 or 5% better efficiency shown for the direct current motor is a relatively small item compared to the total of over 20% existing in favor of the single phase system as above shown. The car transformer further reduces this by about 2%, so the total indicated difference in efficiency is in the neighborhood of 15%. Therefore, what difference exists against this equipment in the matter of maintenance cost per car mile is more than compensated for by the smaller total power consumption, including all losses involved.

The Ignosky Electric furnace for smelting iron, is based on the fact that magnesia and lime, silicon, and other substances become good conductors of electricity at a high temperature. The current first passes over the surface of the ore and then through the molten metal. The furnace is of the rotary type and furnished with various electrodes to prevent concentration of the current in places of slight resistance. By the rotary motion the ore is automatically covered with a layer of slag, thus augmenting conductivity. The furnace is heated to make the interior of the furnace conductive by introducing moist potassium hydrate, and then sodium hydrate and soda.

FACTORS DETERMINING THE EFFICIENCY OF TROLLEY WIRE.[1]

By Carl F. Woods.[2]

No department of electric railroading has received less attention than the transmission line and particularly the trolley wire. In the construction and maintenance of an electric railroad, no expense is spared to obtain power station equipment of the highest efficiency, while the trolley wire, which is just as essential for operation, is generally purchased with no restriction on the quality of material.

The entire development of electric traction has taken place within the past twenty-five years, and this short period of time has witnessed an almost fabulous advance in the improvement of power station and rolling stock. Higher voltages, greatly increased electrical output, heavier and more efficient cars, capable of increased speeds, have been noticeable on all lines. The increasing demands of traffic and the necessity of economical operation have forced the development of machinery of high efficiency. In spite of the great advance along all other lines, the trolley wire of today is not essentially different from that at first installed.

At the present time there are over 25,000 miles of electric lines in the United States; calculating the value of the trolley wire in use, at the current price and assuming the average weight per mile as 2000 pounds, shows a total investment of $8,000,000. This wire is the main artery of the entire system and any injury to it cripples the operation of the road and decreases thereby the efficiency of the expensive generating equipment, and yet an examination of the records of roads operating many hundred miles of track shows that a broken trolley wire is almost a daily occurrence.

Numerous attempts have been made to specify the necessary characteristics of trolley wire, some of which have failed because of an incomplete understanding of the demands upon the material and many more on account of ignorance of the processes of manufacture, and the defects inherent to these processes. The determination of the qualities necessary to an efficient material must always be preceded by a thorough understanding of the conditions which it must meet and by a careful study of the material itself and the limitations imposed by manufacturing processes.

The trolley wire in general use in the United States is made from hard drawn copper, the sizes and shape varying considerably, but circular wire having a diameter of 0.364 inches, which corresponds to No. 2 on the Brown & Sharpe Gauge is perhaps the most common form of construction. Ordinary soft copper does not have sufficient strength for this service so that reliance has had to be placed upon either steel, bronze or hard drawn copper; while steel wire has the requisite strength it is subject to severe corrosion from the weather and has vastly greater electrical resistance. The silicon, phosphorus and other bronzes of a similar nature possess great strength but all have the serious defect of much lessened conductivity. Soft copper wire has a strength of about 34,000 lbs. per square inch, while hard drawn wire can be made having a strength of as high as 67,000 lbs. per square inch. Hard drawn wire although possessing some serious defects has therefore been accepted as being much better than the other materials available for the purpose.

In standard construction, trolley wire is suspended in spans of 100 feet on straight lines and in shorter spans on curves, the distance depending upon the radius of the curve, local conditions, etc. These spans are supported by ears which vary in construction but for the most part depend upon a fixed mechanical grip of the wire. In the earlier construction, ears were soldered to the wire, a process which annealed the hard drawn copper with the consequent reduction in tensile strength, but this practice is now rapidly becoming obsolete. The wire, therefore, is subjected to the pull of its own weight, to the extraordinary stresses of ice and snow and to severe pounding from the trolley wheel. In addition the wheel passing along the wire gives to it a wave motion which proceeds along the wire until an ear or other fixed support is reached where the wave is suddenly checked with a consequent sharp upward bend, followed by a series of bending stresses diminishing in force as the wave motion dies out. On a busy line where cars are operated on a small headway, the wire is subjected to practically a continuous effect of this nature, and in addition to this must be capable of carrying a large amount of power in order to diminish the outlay in feed wire.

To give efficient service under the conditions above noted, trolley wire must possess the following qualities: Conductivity, tensile strength, flexibility, homogenity and toughness.

Each of these qualities is essential and no one of them can be increased beyond a certain point without a proportionate reduction in one or more of the others. For example, certain wires have been made from an alloy of copper and tin which have high tensile strength, great toughness and homogenity, but are lacking in flexibility and have a conductivity only half that of pure copper. On the other hand, by proper drawing, wire can be made very homogeneous, flexible and tough, but lacking in tensile strength, the conductivity being unimpaired. To recapitulate, high conductivity is necessary for economical operation; tensile strength to withstand the abnormal loads; flexibility to enable stringing and to allow the wire to adjust itself under strains and blows; homogenity that the stresses may be uniformly distributed along the wire, and toughness to withstand kinking, wrenching and slow distortion, without giving way.

Attention naturally turns next to the methods of determining to what extent wire possesses these essential properties. The determination of conductivity is very readily and accurately made with a Wheatstone bridge or one of the several appliances based upon the same principle which are especially adapted for trolley wire. Tensile strength may be determined in a testing machine of suitable capacity, but owing to the nature of copper the elastic limit cannot be determined by a drop of the beam, as the metal apparently yields quite steadily up to the breaking point. Numerous conflicting figures are in print regarding the yield point of copper but as a stress and strain diagram shows a nearly perfect curve, the actual elastic limit can only be accurately determined by applying increasing loads for a definite length of time and measuring the permanent set in each case. Such a procedure is obviously too complicated for commercial testing, so that the elasticity of the wire has to be judged by other means. Under ordinary circumstances, power to resist the effects of twisting is not necessary for conducting wire, but the torsional strength measures indirectly but accurately two of the most important mechanical properties that a wire can possess, namely, homogenity and toughness. In a tensile strength test the maximum tensile load is largely a factor of the cross sectional area and the amount of work which has been put into the hardening of the surface. This test will detect inferior drawing or inherent weakness of the copper but it gives no idea of the power of the wire to resist distortion, nor of defects such as oxide seams which run lengthwise of the wire, and do not have a cross sectional area of sufficient size to affect the breaking strength. Under a torsional strain, however, such defects are quickly noted. If the wire contains an oxide seam as above spoken of, the twisting will open it up and at once weaken the strength of the wire. If the wire is of unequal hardness, the twists will tend to bunch up in the softest portion and very noticeably show this spot. Inferior copper not only shows a very low number of turns but splinters and slivers of metal appear on the surface which in very bad wires fall off to such an extent that a paper held beneath the sample during torsion will show a considerable collection of copper fragments. Non-homogeneous copper, due either to impure metal or uneven drawing, will show a great difference in the number of turns which different specimens will stand without breaking, while high grade metal which has been carefully drawn, twists unevenly and uniformly, with no slivering and shows little difference in the number of turns on different specimens. It is therefore, desirable to make at least

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[1]Read Before the Division of Industrial Chemists and Chemical Engineers of the American Chemical Society, December 31st, 1908.

[2]Of the Arthur D. Little Laboratory, Boston, Mass.

three torsion tests, whereas one tensile strength test is sufficient to obtain an accurate measure of the strength.

In the appended table No. 1 are given a series of tests which clearly illustrate the four general divisions into which the trolley wire of commerce may be divided by reason of difference in physical qualities. Specimens A, B, C having tensile strength of 5500 lbs. or higher and torsion tests averaging about 13 represents wire lacking toughness, which has been given a high tensile strength by drawing. Specimens D, E, F having tensile strengths around 5300 lbs. and torsion tests of about 15 are wires lacking both toughness and surface hardness. Specimens G, H, I having tensile strengths of about 5100 lbs., but torsion tests of approximately 23, are typical of wires in which the torsion has been obtained at the expense of tensile strength while specimens X, Y, Z with tensile strengths over 5400 lbs., together with torsion tests of 26 and even higher, represent the best trolley wire which can be made at a reasonable price.

TABLE NO. 1.

Number	Diameter Inches	Torsion Turns in 10"	Tensile Load Lbs.	Conductivity %
A	0.365	14 12 9 Av. 12	5650	98.4
B	0.364	11 12 11 Av. 11	5550	98.6
C	0.362	18 14 16 Av. 16	5500	98.2
D	0.365	18 16 18 Av. 17	5260	98.6
E	0.365	14 15 16 Av. 15	5270	98.7
F	0.364	14 13 14 Av. 14	5370	98.7
G	0.364	21 23 22 Av. 22	5070	98.9
H	0.364	22 25 21 Av. 23	5110	98.4
I	0.365	24 25 24 Av. 24	5210	98.4
X	0.364	27 30 28 Av. 28	5400	98.3
Y	0.364	25 27 26 Av. 26	5490	98.4
Z	0.364	25 28 25 Av. 26	5590	98.2

Of these four classes there is again a distinction in that the first two represent copper of an inferior grade which cannot be made the equal of the wires of the last two classes by any treatment in the rod mill. On the other hand, wires of the last two classes are both made from excellent copper, although specimens X, Y, Z are wires greatly superior in all respects to the preceding three. It is interesting to note that all of these wires have practically the same conductivity which shows clearly the fallacy of attempting to value trolley wire by conductivity and tensile strength alone as is so frequently done.

It is therefore necessary not only to obtain high grade copper but also to secure the proper balance between tensile strength and torsion. These two properties are correlated and increase in one, beyond a certain point, results in a proportionate decrease of the other.

The preceding remarks have shown the conditions under which wire must work and the qualities which are necessary to successfully meet these conditions. Attention must now be turned to the process of manufacture to determine how these qualities may be obtained and what defects of such processes injure the finished wire. For this purpose a brief review of the industry is necessary.

In the refining furnace the copper which is already at least 96% pure from the blister furnace is oxidized by air until a large part of the impurities have been removed and copper oxide is formed in considerable excess. Cuprous oxide is readily soluble in molten copper and acts as a powerful oxidizing agent by giving up its oxygen to any metallic bases present, so that an excess of oxide insures the presence of all metallic impurities in the oxide form. The excess cuprous oxide is then removed by burying a piece of green wood in the molten mass and covering the surface with charcoal. This process must be stopped within very narrow limits as over-reduction will throw the impurities back into the metallic state.

The influence of cuprous oxide has been studied by Mr. Patch of the Detroit Copper Company, Dr. Edward D. Peters, Jr., who is without doubt one of the best authorities on the metal in this country, and by the well known German authority, W. Hampe, among many others. Many of the impurities of copper have been found to be much more injurious when present in the metallic state than when in the form of oxides, and one effect of the cuprous oxide, as above mentioned is to convert these impurities into the comparatively inert and harmless form and so improve the quality of the metal. In large quantities, however, it is known to harden copper while at the same time causing it to become short or brittle and according to Hampe the presence of 1% produces a diminution in toughness.

It is therefore possible to so treat low grade metal that it will have high conductivity although the large amount of cuprous oxide present greatly reduces the toughness. In purchasing copper for drawing trolley wire the manufacturer insists upon conductivity, but as a rule cares little for the other physical qualities, as he can obtain sufficient tensile strength by drawing. Lake Copper possesses both high conductivity and excellent mechanical qualities but this kind of copper costs from one-eighth cent to three-quarters cent per pound more than electrolytic. Why the latter should be inferior to Lake is difficult of explanation, but experience shows that the general run of commercial electrolytic copper is by no means uniform in physical qualities and as a general thing is distinctly inferior to Lake for wire drawing purposes. The cheaper price of electrolytic results in its use by many manufacturers although they frequently understand that the wire will be inferior.

The refined copper comes to the rod mill in bars weighing about 200 pounds each, approximately ten of which are used in the manufacture of a mile of wire. These bars frequently have ridges along the sides, due to faults in casting and the surface is often covered with a layer of oxide. These bars are heated in the furnace until sufficiently soft for rolling and are passed through a series of rolls diminishing in size until a rod of the proper diameter is obtained. The rod is then cooled and drawn through dies, the rods being connected by brazing. The dies give the wire a dense hard exterior coating which increases its tenacity. As the strength obtainable is almost a direct factor of the work expended upon the wire, the smaller the size, the greater the tensile strength per square inch, so that the strength of the trolley wire is readily varied by changing the size of the rod and the number of dies.

One of the most serious defects occurring to wire at this point is from ridged bars as above described. Ordinarily the bar will not be sufficiently heated to dissolve the copper oxide on the surface, so that as the softened bar enters the first passes of the rolls the ridges are lapped over, enclosing the oxide scale. The subsequent passes and the drawing through the dies obscure this flaw almost entirely, but it remains a serious menace to the toughness and the resistance to wear of the copper, as has been previously shown in remarks on the torsion test.

A second cause of trouble arises at the same point by overheating the copper in the furnace, in which case copper oxide is formed on the surface and quickly dissolved through the entire bar, thereby increasing the oxide content and tending toward the production of brittleness. Both of these dangers can be avoided by careful selection of the bars and by proper regulating of the temperature of the softening furnace.

As the production of the hard surface from drawing is at best a rather delicate operation, careless handling, uneven welding of the rods and unequal temperature of the wire while passing through the dies will all produce noticeable effects in the quality of the finished wire, so that care throughout the mill is absolutely necessary for the best results.

It therefore appears that the most efficient wire must possess not only high conductivity, but the maximum torsion and tensile strength possible in commercial copper and that to obtain this it is necessary first, to use high grade copper and to prevent an excess of cuprous oxide entering it at any stage of the manufacture, and secondly, to select as perfect bars as possible and to observe extreme care in every treatment through which they pass. The question at once arises, can such wire be purchased at a commercial price? The writer must admit that this high grade wire can not be obtained at the ordinary market price, but requires the payment of a premium of one half cent per pound. To produce wire of this grade consistently the wire manufacturer must use the higher priced Lake Copper and observe unusual care in its treatment so that he is justified in demanding a higher price. Experience in the use of this wire has shown conclusively that it is well worth the additional cost.

TABLE NO. II.

Number	Diameter Inches	Torsion Turns in 10"	Tensile Load Lbs.	Conductivity %
1	0.363	22½ 24¾ 22½ Av. 23½	5470	99
2	0.364	23 25 23 Av. 23½	5490	98.7
3	0.363	19¾ 25½ 17½ Av. 21½	5400	97.8
4	0.363	23½ 25½ 23½ Av. 24	5470	98.8
5	0.363	22½ 21¾ 24 Av. 22¾	5450	97.8
6	0.363	24 20 24¼ Av. 22¾	5500	98.6
7	0.363	22½ 24 23¾ Av. 23½	5420	97.8
8	0.365	23 24 20 Av. 22	5510	98.5
9	0.363	24 19½ 23½ Av. 22	5540	98
10	0.363	21 23 21 Av. 21½	5470	98.8
11	0.363	22 22½ 23 Av. 22½	5490	98.8
12	0.363	26½ 26½ 23½ Av. 25½	5500	98.5
13	0.363	23 20½ 24 Av. 22½	5450	98.7

The appended table No. 2 gives the results obtained upon 13 consecutive miles of trolley wire made from selected bars of Lake Copper. The tests were made upon each mile of the wire and the results show the great uniformity obtainable by proper care. It should be said in this connection that this wire was not made as an experiment but was drawn by a certain wire company as a part of a regular business contract.

The point must be kept clearly in mind, however, that even the best of wire is of little value if improperly used, and the consumer must realize that the same degree of care which he insists upon from the manufacturer, is essential in the handling and stringing of the finished wire.

The study of copper wire and the demands made upon it show the great need of a more thorough knowledge of this material. Owing to the minute quantity of impurities which exert a marked effect upon the qualities of copper, a chemical analysis is too difficult for technical purposes. The iron and steel industry is largely controlled to-day by micro-chemistry, and, in the same way, there is a future for this same practice in the copper industry. Of first importance, is a careful working out of the copper-cuprous oxide system with the determination of the number of phases occurring and the physical properties incident to different alloys. Doubtless much of this information is already in the hands of the copper refiners, but it remains for chemical engineers and chemists interested in industrial materials to verify and complete the work for the consumer.

No Speculation in water rights is legal according to a decision of the Supreme Court of Oregon which makes it impossible for any person or corporation to hold a power or irrigation right for speculative purposes. Those persons, therefore, who have filed on water powers on the Deschutes and other rivers must put the water to a beneficial use or forfeit the right to the first person who does apply it to a beneficial use. This applies to persons acquiring rights subsequent to the congressional act of March 3, 1877. The court holds that this act limits all riparian rights subsequently acquired except to the extent of the use of water for domestic purposes. The case was that of Annie C. Hough et al., respondents, v. S. A. D. Pueter et al., appellants, from Lake County.

The Rochling-Rodenhauser Furnace is operated by three-phase currents. Already more than 1,000 tons of steel rails have been made for the German railroads in this new furnace. One of the chief disadvantages of all single-phase induction furnaces is that special generators are required, producing a current of low frequency. In the new type, now described, this problem has been completely solved. A new 15-ton Rochling-Rodenhauser furnace is operated with currents of a frequency of 50 periods and is directly connected to the ordinary three-phase supply network of the works. Three-phase current furnaces are now built for charges up to 3 tons, while with a frequency of 25 it is possible to increase the charge up to 8 or 10 tons. The hearth of a 15 ton furnace is 19 in. wide and 59 in. long. The three transformer cores are surrounded by heating channels. Where two such channels meet the main hearth, pole plates are provided. Each of the three transformer cores is provided with a primary winding. Above each primary is a secondary winding, one end of which is connected to a bus-bar, and the other ends to the pole plates. A peculiar feature of this type furnace is the rotation of the charge, due to the presence of a rotary field as in an induction motor. In this manner an excellent automatic circulation is provided. These furnaces produce steel superior to that of the open hearth process, especially with respect to its greater density and homogeneity. The energy consumption for a liquid charge is from 200 to 300 k. w. hours. The voltage and current curves are almost straight lines, which shows that sudden variations in the load need not be considered. The power factor is from 0.75 to 0.80.

SOME RECENT ADVANCES IN ELECTRO-CHEMISTRY AND ELECTRO-METALLURGY.[1]

By Saul Dushman.

The application of electrical energy to the performing of a large number of reactions previously carried out by purely chemical methods, has at the present time attained to a position of great commercial importance. This has been due largely to the rapid developments that have taken place in the methods of power production. So long as the cost of electric power was high, the idea of supplanting ordinary chemical or metallurgical processes by the more simple electro-chemical ones could not be entertained, and electro-chemistry remained practically a laboratory science. But it was during this period that the foundations were laid for many of the most important electro-chemical industries of the present time, and, as a result, the advent of cheaper electric power found the electro-chemist prepared to utilize the advantage which was thus held out, and during the last decade the progress in electro-chemistry has been so enormous that in many cases the electric power plant has been installed on account of the electro-chemical consumers.

Some of the electro chemical industries, such as the carbide, carborundum, aluminium, copper-refining and caustic soda processes, have long since passed beyond the experimental stage, and their products have become vital necessities in the industrial world. Other processes, however, have obtained a great deal of prominence in the last few years, which cannot be said to be as yet in a state of assured stability, and these, since they are probably not so familiar to many of our readers, form the subject of the present article.

It is a long step from the time of Cavendish to the present, but the relatively unimportant fact discovered about the year 1776, that an electric spark passed through a moist mixture of oxygen and nitrogen will produce nitric acid, is the basis of a large number of projects, that have recently become technically important, for the fixation of atmospheric nitrogen. As is well known, our wheat crops require for their successful growth, a certain amount of fertilizer to be supplied to the soil. Nitre, or Chili saltpeter has been the substance chiefly used for this purpose in the past; but the beds of nitre in Chili are gradually becoming exhausted, and even if the supply be available for a much longer period than Crooks averred in 1892, the world has come to realize that some other source of fertilizers must be sought for, if its food supply is to remain assured. The essential requirement of a fertilizer is that it shall contain nitrogen, in a form which can readily be absorbed by plants; this condition is fulfilled very well by nitrates. Now all around us, constituting the very atmosphere we breathe are present the essential components of nitric acid, and it is therefore not surprising that the old experiment of Cavendish has again been brought to light and the question has arisen how the fixation of atmospheric nitrogen may be performed on a commercial scale?

Lack of space will not permit us to review the preliminary work of different experimenters in Germany and England who, during the years 1897 to 1904, sought to solve the problem. Their experiments, although they did not result successfully from a commercial point of view, led to the conclusion that the main reaction in the electric arc is the formation of nitric oxide according to the equation.

$$N_2 + O_2 \rightleftarrows 2NO,$$

the amount of NO increasing with the temperature and depending at constant temperature on the concentrations of the components, according to the Mass Law. It was also shown by Nernst that the proportion of air converted into nitric oxide is always very small, and even at 2600° C, it amounts to only two per cent by volume.

These investigations thus prepared the way for the first commercial process, that devised by Birkeland and Eyde in 1904. They use a 5,000 volt alternating current arc between water-cooled copper electrodes, and by means of a magnetic field at right angles to the latter, the arc is spread out into a disc over 2 meters in diameter, thus causing almost the whole volume of air in the furnace to be raised instantaneously to a very high temperature. Owing to the circulation of air through the furnace, the nitric oxide formed there is cooled before it has a chance to dissociate, and combines, at 600° C, with oxygen to form the higher oxide, NO_2. This is passed through a series of towers washed with water and gives a 50 per cent nitric acid, which is then saturated with lime and converted into a basic nitrate useful as a fertilizer. The furnaces used by Birkeland and Eyde are each of 500 kilo-watt capacity, and while in their original plant at Nottodden, Norway, only 1,500 kilo-watts were used; this has since been increased to 40,000 k. w. The yield is 70-83 grams pure nitric acid per kilo-watt hour, which corresponds to 500-600 kilograms per k. w. year, and the inventors claim that this figure can be considerably increased. It may, however, be stated in this connection that the main reason for the success of this process is the fact that power in Norway can be obtained at the extremely low price of approximately $5.00 per h. p. year, a figure which is probably much lower than that quoted in other countries.

Simultaneously with the Birkeland-Eyde process there has been developed another one by the Badische Anilin and Soda Fabrik. "They employ an arc in a long tube through which air is passed in a whirling motion. Since 1907 they have operated an experimental plant of 2,000 h. p., and are now planning the erection of a large 120,000 h. p. plant."

The problem of the fixation of atmospheric nitrogen has also been solved in a totally different manner. A few years ago the search for a commercial method of producing cyanide of potassium led Drs. Frank and Caro to the discovery that when nitrogen is passed over calcium carbide at a high temperature such as that of the electric furnace, there is produced a compound having the formula $Ca\ CN_2$ and known as cyanamide. This substance is capable of yielding a large number of interesting derivations by treatment with suitable reagents; thus by melting with certain fluxes it yields potassium and sodium cyanides; by the action of steam it gives off ammonia which may be converted into ammonium sulphate, and it has also found application in the organic dye industry as well as in the tempering and hardening of steel. But its most important use has been found to be as a fertilizer. Investigations by Dr. Hall at Rothamstead have shown that as a manure it is equal to nitre or any of the artificial fertilizers. It is, moreover, cheaper than the basic nitrate produced by Birkeland and Eyde. According to Dr. Frank, "to replace the present consumption of Chili nitrate by cyanamide would require something like 800,000 h. p., and works are springing up all over the world to produce it wherever water-power is abundant and cheap." The original works of Frank and Caro at Piano d'Orte, in Italy, are being extended at the present time to an output of 10,000 tons and numerous plants are installed or being contemplated in various European countries as well as in America. The United States Cyanamide Company is erecting a 5,000 to 6,000 tons works, at Niagara Falls, Ontario, and will shortly build another installation in Tennessee.

While important progress has thus been made in processes for the utilization of atmospheric nitrogen, electrical methods have also been invading a field in which at first there seemed to be little probability of their gaining a foothold. But the cheap, efficient manner in which electrical energy can be applied instead of coal in many branches of the iron and steel industry has caused the new methods to become an important factor even here. During the later part of the nineteenth century immense strides had been made in both the theory and practice of iron smelting. The conditions governing the nature of the product obtained in the blast-furnaces were investigated thoroughly; so that the iron metallurgist could produce an iron of any desired quality. Similar progress had been made in the manufacture of steel. But the scarcity of coal in many places where both ore and

[1] Applied Science.

cheap power are available caused many persons to consider the advisibility of using electricity to do the work ordinarily performed by coal. The report of the Canadian Commission has been long enough before the public for all to become fairly familiar with its contents, and a great many Canadians have come to realize the immense possibilities of electro-thermic processes in this country. However, the time seems hardly ripe for an extensive development of electrical iron smelting, and we cannot do better than quote, in this connection, the opinion of Mr. J. Harden, a noted metallurgist. After comparing the two processes for reduction of iron ore, he concludes that "where conditions are the same in both cases, as to the class of ore, amount of labor, and class of fuel available, the electric smelting furnace requires an expenditure of $9.70 per ton of produced iron, while the blast furnace requires only $6.84 or $2.86 less per ton of iron." He then reviews the difficulties which have occurred in the various types of electric furnaces, and makes the following noteworthy remarks:—

"It is certainly not our intention to stamp the electric smelting furnace as a hopeless impossiblity—far from it; but it is only intended to state things as they are at the present, and keep some of those optimists a little nearer the earth who dream that the days of the good old blast furnace are doomed, and must give way to the more modern electric smelting. We certainly believe that the smelting furnace is capable of attaining perfection, like everything new, but all improvements must go steadily forward, not in leaps and bounds, as the effects of undue rashness are only leading us astray." His conclusion is that electric smelting would be justifiable only in such regions as India or Western States of U. S. A., where there is practically no coke, while there are large deposits of cheap ores and abundant water-power. The carbon required for the chemical reduction could be obtained by converting wood and forest waste (which may be had there in large quantities) into charcoal.

While the success of electric smelting is thus still a probability, the production of steel in the electric furnace has become an established process. The first steps in this direction were made by the carbide and aluminum producers at a time when an overproduction of these products on the European market threatened many electro-chemical installations with absolute ruin. Naturally, the products initially turned out were more or less novelties, like the ferro-alloys. A gradual education of the steel consumers has, however, not only led to a greatly increasing demand for such special alloys, but has also encouraged the electro-chemical manufacturers to enter upon the production and refining of steel. Here the electrical processes possess undoubtedly superior advantages, both from the point of view of efficiency and of ability in controlling the quality of product; and when Mr. Chas. M. Schwab states that in his opinion the near future will see the electric steel furnace an essential part of all existing steel plants, it is evident that the advantageous results to be obtained by using the new process have been perceived by the most important steel producers.

Out of the large number of new developments that have occurred in this industry within the last couple of years, two are especially worth noticing. One of these is the Lash steel process, the object of which is to make any desired steel by properly mixing ore, cast iron and carbon and then subjecting the mixture to heat. "The essential features in the process seem to be the fine state of division of the constituents of the mixture, their intimate association, and the use of iron containing metalloids in considerable quantities."

The other great development has been the Roechling-Rodenhauser modified induction furnace. The ordinary induction furnace is in reality a transformer in which the secondary is constituted by a ring of molten metal. Owing to the high temperature of the latter, careful heat insulation has been found necessary from both the primary and magnetic iron core. The result has been a considerable magnetic stray flux and consequently a low power-factor. Attempts have been made to reduce this defect by lowering the frequency of the alternating current generators, and frequencies as low as 15 have been used. But the most recent innovation due to Messrs. H. Roechling and Rodenhauser of the Roechling iron and steel works in Voelkingen, Germany, consists in having an additional secondary coil connected with metal plates which are separated from the molten bath by a refractory electrolytic conductor of the same kind as used in the Nernst lamp, so that the metal is heated not only by induction currents but also by currents passing through it between the electrode plates. Single-phase current was originally used in this furnace, but more recently three-phase current has been used successfully, and it has been found possible to operate such furnaces economically with alternating current of ordinary frequency, so that the necessity of building special and expensive generators is thereby obviated. The principal use for this type of furnace is in further refining the steel after it is blown in the converter, the additional cost of electric refining being more than compensated by the greater density and homogeneity of the product. It is also interesting news that by this method more than 1,000 tons of steel rails have been made and sold by the above iron works to German railroads.

Not only in the electro-metallurgy of iron and steel but also in other fields of electro-chemistry there have been many signal advances. Acheson's deflocculated graphite and Potter's "Monox" form the latest additions to the already large number of electric furnace products. The former of these is the result of Mr. Acheson's discovery that fine pure graphite (which he succeeded in producing during 1906) when digested with water containing a trace of tannin becomes capable of remaining suspended in the water for an indefinitely long time, forming as it were a colloidal solution. In this condition, the graphite is designated by its inventor as "deflocculated," and the aqueous suspension has the singular property of being an excellent lubricant. When added to oil, deflocculated graphite reduces its co-efficient of friction considerably. It therefore seems as if it will obtain important commercial application.

Dr. Henry Noel Potter has obtained silicon monoxide by reducing silica at the temperature of the electric arc either by silicon or coke. The temperature thus produced which has the formula SiO (analogous to CO), has been called "monox" by its inventor. In the air, it burns very readily to silica and this explains why it has not been obtained under the conditions existing in the carborundum furnace. In the furnace designed by Dr. Potter a mixture of sand and coke, or carborundum fire sand, is subjected to the action of an electric arc between two horizontal electrodes which are covered by the charge. As soon as the reaction begins, the monox vapor produced blows a funnel-shaped hole through the charge and is then chilled by contact with the walls of a large enclosed drum which covers the top of the charge. As this drum is practically free from air, the vapor does not burn but is condensed as a deposit on the walls of the container. The solid monox is a fine, opaque, light-brown powder which possesses many interesting properties. It has been found to be a valuable pigment in certain oil paints, in particular paints for brick-work and paints for protecting structural iron from rusting. It is also a good addition to black printing inks; and the probabilities are that many other uses will be found for it.

This completes our brief survey of some of the recent advances in electro-chemistry and electro metallurgy. A great many things have necessarily been omitted; such as the work done by Edison and others on the iron-nickel accumulator; the electrolytic refining of lead, silver, and gold; the production of caustic soda and chlorine in the Townsend cell; the aluminum rectifier, and numerous other topics. But perhaps even the above few remarks may serve to show that not only has the development of electro-chemistry in recent years taken place in many directions that even the most imaginative scientists of twenty years ago did not foresee, but also the future will probably see more and more of the ordinary chemical and metallurgical operations replaced by the electro-chemical processes. Especially will this be so for our own province, where, as well-known, hydro-electric power is readily available, and there is an abundance of the choicest raw materials.

PUBLICITY AS TO EARNINGS.[1]

By W. J. Grambs.

As a rule a company will not publish the fact that it is losing money, and if it does, it receives very little sympathy on account of that fact from the public. If the central station publishes an annual financial statement and in such statement shows that it has made due provision for future renewals and maintenance and perhaps set aside other sums for necessary extensions, and in this way takes the public into its confidence, a great many of the erroneous impressions which are now entertained by the public in regard to the larger profits made by public utility corporations might be removed. In states where public service commissions have been created, all of this information has been made public and is available, and the public is being educated to the fact that public utility companies are, in many cases, and particularly in the small towns, losing money, and that such companies as are getting a fair return on their investment are rather few and far between. A great deal of the municipal ownership agitation will be quieted and cities and towns will hesitate to embark in such enterprises when they realize that it is a grave question whether the municipality can show net earnings where a private company has failed.

A recent issue of a service journal commented on the courage displayed by the Kansas City Railway and Light Company in publishing in an annual report to its stockholders a statement from chartered accountants that, in their opinion, the allowance from income for accruing renewals and depreciation was not adequate for the maintenance of the property over a series of years. It appeared that the company set aside $829,000 during the first years ending May 31st, 1908, toward charges of the nature stated, but after allowing for the fact that during a great part of this period the property had been in process of reconstruction, this amount was not, the accountants thought, sufficient.

Too little regarding the accounts and earnings of electric properties has been made public in the past. This is partly due to ignorance concerning the true cost of service, and partly because of a failure by those who know the facts to make them public. Accounts that are made public should come as near the truth as is possible for them to be made. If companies declare dividends without a statement that they were not earned if account is taken of the accruing need of provisions for renewals and maintenance, if such is the fact, the public assumes with justification but without knowledge, that the profits divided were earned.

Publicity respecting existing and probable requirements for maintenance places a company in a light before municipal and state regulating bodies which it can secure in no other way. Public authorities will reach the point eventually where they will recognize the right of utility corporations to a return on the investment reasonably made in the property. If they do not recognize that right of their own volition, the courts, in the end, will force them to do so as a matter of justice to the security-holders whose funds have been invested in the enterprise. If the existing rates will not permit such return the rates will have to be amended in order to bring about the desired results.

Appeals to civic pride and loyalty, the company co-operating with local commercial bodies, are indirect forms of publicity. Carefully prepared statements for publication, showing the growth of the company's business as an index of the town's growth compared with other towns, all help to mould public opinion and appeal to civic pride.

The companies engaged in furnishing public service must, in their own interest, strive more and more to give good service at fair rates. The time has gone by when extortionate rates and wretched service will promote the interests of the corporation. Good service, fair rates, courteous treatment and publicity will win out in the long run. He who serves the public best serves his company best.

Patience, a spirit of conciliation and a real desire to increase facilities and reduce charges as rapidly as consistent with sound management, will ultimately bring their rewards in the form of increased earnings and larger dividends. And when the public in any community begins to see that notwithstanding the howling of demagogues and agitators, it is being fairly treated by the corporations, its objections to large and increasing returns upon invested capital will gradually disappear.

Public sentiment must be cultivated; the one great need is popular education along sound economic lines. We cannot afford to leave the exploitation of vital economic principles to the visionary, or the doctrinaire, on the one hand, or to the irresponsible politician or selfish agitator on the other. A real campaign of education is what is needed, a broad, comprehensive, intelligent, persistent, aggressive and well-directed campaign of publicity, which shall leave nothing in reason undone to spread sound economic doctrines.

In regard to self-interest, having in mind the rights of all, let it be devoted to the fundamental proposition that all members of the community are bound together in such intimacy of relation that no member can ruthlessly injure another without ultimately feeling the recoil upon himself. "Live and let live" should be the motto.

[1] From paper read at meeting of Northwest Electric, Light and Power Association, Portland, December 18, 1908.

PROFIT SHARING ON THE SPOKANE AND INLAND EMPIRE RAILROAD.

Jay P. Graves, president of the Spokane and Inland Empire Electric Railroad Company, operating interurban lines in Washington and Idaho and power plants in and near Spokane, has addressed a letter to the officers and employes of the entire system, setting forth a plan by which they may become stockholders and share in the company's profits. The letter follows:

"A number of corporations in the United States, have, during the last few years, adopted plans whereby their employes were afforded opportunities for acquiring their stock or securities on safe and easy terms, believing that thereby employer and employe were brought closer together to their mutual benefit.

"Believing thoroughly in the principle, and desiring to bring about and maintain between this company and its employes a community of interest and consequently good feeling, the company has arranged with the Union Trust Company of Spokane to supply to any officer or employe of the company shares of its preferred rights or preferred stock at the going market price, plus an interest which may have accrued on the purchase price between the time of purchase by the Trust Company and its sale, and a commission of 5 per cent on the amount purchased. No profit is made by the Trust Company except the commission, it purchasing the stock in the market and selling it to the purchaser at cost.

"Easy terms will be made, the purchaser paying not less than 15 per cent of the purchase price in cash, and deferred payments being arranged to suit the purchaser, provided that not longer than five years' time will be allowed, the deferred payments bearing interest at 5 per cent per annum.

"In case the purchaser becomes sick or disabled, leaves the service of the company, is discharged, or dies before the stock is paid for, the Union Trust Company will, if requested to do so, cancel the contract and repay to the purchaser, or in case of death, to his heirs, all sums paid on account of the purchase price. After the purchase is completed, the company will, in any of the events above stated, take the stock off the hands of the purchaser, or his heirs at the price paid for same, plus five per cent per annum interest and less any dividends on the shares that may have been paid.

"The par value of the shares is $100, the selling price by the Trust Company to be the cost plus commission and interest. Holders are entitled to dividends at the rate of 5 per cent per annum before dividends are payable to holders of the common stock. Above 5 per cent, up to 7 per cent the two stocks share equally in dividends. The shares are redeemable at any time by the company upon the payment of $135 a share and accrued dividends. Owing to the recent financial depression, it is believed that the shares can now be purchased for less than par."

CURRENT COMMENT

A glass telephone mouthpiece that can be taken off for cleaning or boiling has been devised to obviate unsanitary conditions.

Tungsten lamps for electric signs are now available as a four candle power 5 watt lamp, operated on a ten volt circuit supplied by a small ten volt transformer mounted near the sign.

A bill to fix rates for electricity has been introduced in the California Legislature by Senator Miller. Telephone rates are also limited by the bill so as to give a minimum return on the investment.

The highest European voltage in transmission lines is that of the Sociedad Hydroelectrica Espanola Molinar in Spain, which is being built for a potential of 66,000 volts and will transmit 25,000 kilowatts 150 miles to Madrid.

A medal for the wireless operator of the White Star liner Republic, Jack Binns, has been awarded by the French government because he staid at his post when the Republic was rammed by the Florida off Nantucket recently.

Electrocution of ants has been found to be the only effective means of ridding the residences and gardens of Panama of these pests. Any area surrounded with wire carrying a moderate electric current may be thus protected.

Wages of Westinghouse employees have been restored to the scale existing in March, 1908. The cut had been made by William Donner when he temporarily assumed charge of the business of the Westinghouse Electric and Manufacturing Co. When George Westinghouse resumed control he ordered that the previous wage scale be restored.

A Museum of Safety and Sanitation has been organized to prevent the enormous loss of life and limb in America. Safety devices for dangerous machines and preventative methods for combating disease will be exhibited at the offices in the United Engineering Societies building in New York City. Mr. Frank A. Vanderlip has accepted the treasurership.

The water power of the United States aggregates 5,250,000 horse-power in use, according to the estimate of the National Conservation Commission; the amount running over government dams and not used is 1,400,000 horse-power, and the amount reasonably available not only equals the entire mechanical power now in use but is enough to operate every industry in this country.

The scrap heap of the Philadelphia Rapid Transit Co. is the basis of a big saving. Old bolts are re-threaded or cut down to stock sizes and other worn parts are worked over. All brass journals, check plates, car trimmings, bolts and carbon brushes must be returned before new ones will be issued. Carbon brushes are given a new lease on life by being cut down for smaller motors.

A new type of induction furnace has been patented in France by Mr. Frick. The object of the invention is to decrease, by aid of a special arrangement of the primary coil, the field of dispersion of this coil, and the self-induction voltage caused by the latter, so that the power factor of the feeding-circuit can attain a more advantageous degree than in existing furnaces. Another high-voltage furnace has also been patented in the same country by Messrs. Limb & Lewis, specially applicable to nitrification of atmospheric air. The device consists essentially in a new system of deflagration in a suitable recipient, allowing entrance and exit of gas, made of unattackable metal or fire-bricks, with or without glass windows, of any shape, but preferably flat.

Increase in Japanese water-works systems has created a large demand for pipe. In order to foster home industries, the Japanese government has placed a duty of 30 per cent ad valorem upon pipes and tubes, the duties being calculated on the actual cost of the articles at the place of purchase, production, or fabrication, with the addition of the cost of insurance and transportation from the place of purchase, production, or fabrication, to the port of discharge, as well as commissions, if any exist. The conventional rate, which is enjoyed also by American exporters, is 10 per cent ad valorem. The tariff duties therefore being equal, it should be possible for the manufacturer of light, strong pipe in America, which does not eat up the profits in transportation and which is sought by the Japanese, to compete most successfully with the European producer, though such efforts will prove futile unless he follows the plan adopted by his competitors—personal representation.

A novel magnetic ore separator is being used in Sweden to concentrate 32 per cent iron to 62 per cent iron ore. It consists of a short conical drum of non-magnetic material revolving on a horizontal axis, and provided inside with a number of pieces of iron separated from one another by cement. Outside the drum and under it are three electromagnets, taking, in all, 10 amperes at 110 volts, and connected so that the two outer ones are of like polarity. As the pieces of iron and the drum approach the magnets, they become magnetized and attract the iron of the finely-divided ore fed into the drum. This attracted ore is carried round a certain distance, and then falls off automatically on to a sheet of metal projecting into the drum. From this it is washed off on to an endless conveyor belt by a stream of water. This belt is provided with thin iron strips, which also becomes magnetized whilst in the neighborhood of the magnets, and so keep the ore from falling off again. After the belt leaves the drum the ore is washed off by means of more water into a receptacle. The non-magnetic portion of the ore gradually falls out of the end of the conical drum as it rotates.

Wireless operators on the Pacific Coast are vying with each other in an effort to break the transcontinental wireless record. The strongest rivalry for this honor has developed between the operator at Point Lomas in southern California and the corps of operators employed in the Russian Hill station of the United Wireless Company in San Francisco. Thus far the local station has achieved two notable victories having established regular wireless communication between this Coast and Honolulu and in having caught brief messages from a lonely isle in the Japanese Empire. Since it is more difficult to transmit aerial messages over land, the greatest achievement will be in the establishment of communication with Pensacola. The race for Pensacola through the air began on January 7, when the operator at Point Loma requested that all other Coast stations "keep off" the line until Pensacola was "found." This message only served to stimulate interest in the race, and as the word was passed along from station to station, the operators decided to "get" Pensacola, and as a result there have been many attempts made to bridge the transcontinental gap. Enthusiastic and ambitious young operators assert that the feat can be performed.

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CONTENTS

A Possible Power Consumer

Notwithstanding the enormous amount of electrical energy developed by the abundant water powers of the Pacific Coast, the demand for electrical power has always been greater than the supply. Thus it is that part of the power generated by the Great Western Power Company in California has been purchased outright by the Pacific Gas and Electric Company, whose great output is yet insufficient to supply the needs of its distributing system. Thereby the Great Western Power Company is also spared the expense of building a costly distributing system of its own. Because of the same fact there is comparatively little active solicitation by electric companies for new business in competition with other forms of energy for power and light.

With the completion of the many contemplated western power developments, these conditions can be maintained but a short time at best and central station managers will soon be on the lookout for new consumers of their product. In line with the experience of other localities one of the most satisfactory means of utilizing electric current is that in the manufacture of compounds that require the intense heat of an electric furnace. Quite a cluster of such industries have gathered around Niagara Falls in this country, and several of the European hydro-electric plants. As noted several times in these columns the experiments in the electric smelting of iron ore in Shasta County, Califronia, are meeting with success and will be the probable basis of the industrial advancement of the West, heretofore retarded by the lack of cheap iron. With its great wealth of natural resources as a supply for raw material, and its wonderful water powers the West offers peculiar inducements for the establishment of electro-chemical and electro-metallurgical works.

Specifications For Copper Wire

A French investigator has recently completed an exhaustive series of experiments on the conductivity of alloys in an attempt to find some metal of a lower resistance than those hitherto employed for electrical purposes. He finally came to the conclusion that his quest was hopeless and that all that could be expected was to improve the physical and chemical properties of known conductors so as to give the least loss of conductivity.

For commercial work there are two additional factors of equal importance to be considered, that of strength and that of cost. For without strength a good conductor is of little use, and without cheapness neither low resistance nor great strength are economically available. Thus silver has a lower resistance and a greater tensile strength than annealed copper, but its cost is many times greater. Therefore, everything considered, either copper or aluminum are now accepted as the best conductors.

Investigation has shown that the properties of copper are almost as variable as those of iron. These variations are in a measure largely due to the same

cause, difference in chemical and physical conditions. For copper this is particularly true with reference to the amount of cuprous-oxide present, which reduces its toughness and resistance to wear. The effect of these impurities on trolley wires are given in an able article in this issue by Mr. Carl F. Woods. While he deals solely with trolley wires, these conditions similarly apply to all the varied uses to which copper is put in electrical industries. These impurities are so small in amount as to defy ordinary methods of chemical analysis, and the suggestion is accordingly made that they be found by a microscopical examination of thin sections of the metal. This method has been employed with marked success in the iron and steel industry and is the basis of specifications of several manufacturers. Micro-chemical examination of copper has formed the subject of interesting experiments and it is now high time that these results, if practical, be given publicity. It is quite possible that they, too, will form a true index by which the consumer may be sure of the quality of the material which he is purchasing.

LITTLE DAMAGE IN RENO.

Newspaper reports of the damage to the light and power plants around Reno, Nevada, by recent floods were greatly exaggerated. About 120 feet of flume were carried away by a land slide, necessitating the temporary shut-down of about one-third of the power. This was quickly remedied and conditions are now normal in the system controlled by F. G. Baum and associates.

TRADE CATALOGUES.

The Norman W. Henley Publishing Co. of New York City has issued a new catalogue of scientific and practical books which will be sent to anyone desiring it.

The Blake Signal and Manufacturing Company, of Boston, Mass., have issued a new folder on their soldering flux, giving a new scale of prices that has been in effect since January 15, 1909

The Condit Electrical Manufacturing Company of Boston have issued several interesting bulletins on oil circuit breakers and switches, which are handled locally by W. A. Ekberg of San Francisco.

In Bulletin No 4642, just issued by the General Electric Company, is described a new trolley base designed especially to fulfill the requirements resulting from the increased speed of interurban cars and the consequent severe conditions.

In a folder, No. 3750, just issued by the General Electric Company, is described the Company's Improved Type H Transformer. This transformer embodies all of the high qualities of the older types as well as various improvements, resulting from broad experience in design and construction.

Pamphlet No. 3728, just issued by the General Electric Company, gives, by means of tables and curves, a brief exhibit of the value and economy of Tungsten Series Street Lamps, showing the marked saving over the carbon and Gem lamps, and the possible gain in income. It shows the rate at which the tungsten lamp is able to compete with Welsbach gas street lamps, the economical life of the tungsten lamp, the relative cost of producing a candle-hour of light with the tungsten as compared with the carbon and Gem, and the candle-power and life performance of the tungsten series lamp.

PERSONALS.

A. S. Kalenborn, engineer with F. G. Baum and Company of San Francisco, is at Reno, Nevada.

J. C. Wells of Washington, D. C., who is connected with the Forest Service, is in San Francisco.

H. F. Jackson, engineer for the Stanislaus Electric Power Company, was in San Francisco this week.

Garnett Young, manager of the Telephone and Electric Equipment Company, of San Francisco, is in Los Angeles.

J. A. Lighthipe, engineer with the Los Angeles Edison Electric Company, is expected in San Francisco this week.

Frank C. Kelsey of Portland, Oregon, has charge of the construction of the Tacoma municipal electric power plant.

W. H. Graves, president of the Northwestern Engineering Co., has opened offices in the Wells Fargo building, Portland, Oregon.

Alexander J. Rosborough, secretary of the Yreka Light and Power Company of Yreka, California, is visiting San Francisco.

A. B. Jennings, engineer for the Jeansville Iron Works of Hazelton, Pa., has returned home after a brief visit to San Francisco.

G. B. Bush of the San Francisco office of the Pacific Telephone and Telegraph Company, spent the past week in Los Angeles.

Horace Clark, with the San Francisco office of the Westinghouse Air Brake Company, has returned from an extended trip to Los Angeles.

E. N. Fobes of the Fobes Supply Company, Seattle and Portland, who has spent some time in the vicinity of Del Monte and San Francisco, returned to the Northwest on January 27th.

H. H. Manny, formerly Northwest manager for the Telephone and Electric Equipment Company, has opened an office with B. R. Myers at 406 Central building, Seattle, as dealers in electric supplies.

M. H. Grover, manager of the San Vincente Lumber Company of Santa Cruz, California, was in San Francisco this week with regard to the electrical equipment of his planing and saw mill

F. A. Bishoff, manager of the indus rial and power department of the Chicago office of the Westinghouse Electric and Manufacturing Company, is returning from Idaho by way of San Francisco. While in Idaho he obtained the contract for a $150,000 Government pumping station.

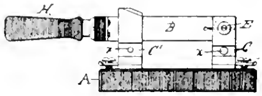
W. A. Thomas and H. A. Klink, commercial engineers with the Westinghouse Electric and Manufacturing Company, are in San Francisco. In the course of a tour of the United States they have been investigating the special application of electric motors to various classes of work, including mining requirements.

Karl G. Roebling and F. W. Roebling, Jr., of John A. Roebling's Sons Company, Trenton, N. J., were in San Francisco during the past week on their annual inspection of their various houses. They reached San Francisco from Portland and Seattle and left for Los Angeles where they will spend a few days, returning East from there.

A. M. Hunt, in view of his high position among the electrical fraternity in the West and his earnest endeavors in promoting the interests of the Institute, is to be put forward as a candidate for one of the vice-presidencies of the American Institute of Electrical Engineers. Local representation has not been had since F. G. Baum occupied a similar position and it is deemed just that some recognition should be accorded the West.

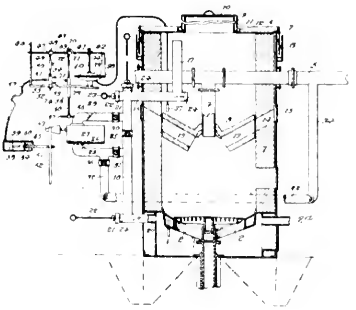
PATENTS

910,328. Knife-Switch. George B. Thomas, Bridgeport, Conn., assignor to The Bryant Electric Company, Bridgeport, Conn. An electric knife-switch having a blade with its hinging



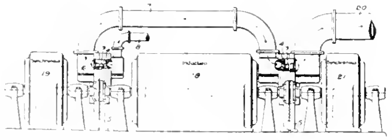
end split and offset, in combination with a hinging post in the form of a clip to embrace the split end of the blade, and means to press the offset parts of the blade between the parts of the clip.

910,319. Gas-Producer. Peter G. Schmidt, Tumwater, Wash. Filed March 7, 1908. A producer comprising a casing, a grate in the casing, a shield above the grate, a pipe leading from the upper part of the casing to the space beneath the grate, said pipe being provided with a by pass, an exhauster in the by-pass, a cone pulley in connection with the exhauster, a normally closed valve in the pipe between the ends of the by-pass, a pipe leading from the by-pass beyond the exhauster,



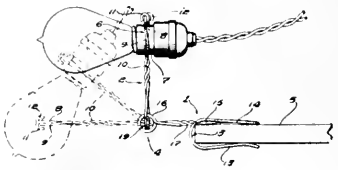
and delivering to the shield, a valve for closing said pipe, a valve beyond the by-pass for closing the first pipe, a thermostat in the casing in the distillation zone, a cylinder adjacent the producer, a piston in the cylinder, a belt for driving the pulley, a shifter for the belt connected with the piston, means operated by the thermostat for moving the piston in one direction, and a spring for moving it in the reverse direction.

910,164. Elastic-Fluid Turbine. Ernst J. Berg, Schenectady, N. Y., assignor to General Electric Company, a Corporation of New York. A turbine comprising stages each having



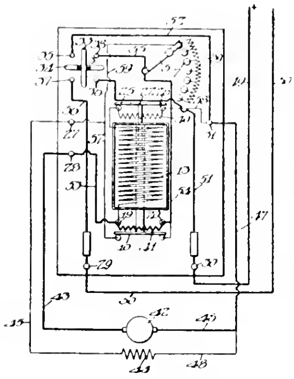
bucket wheels, in combination with a member located between the adjacent wheels of the different stages and driven thereby, and other members located on the opposite side of said stages and driven by the outer wheels.

910,158. Incandescent Electric Lamp Holder. Frank Walker, Los Angeles, Cal. An incandescent electric lamp holder comprising a member adapted to engage a support and having an eye; a second member formed of wire bent upon itself at the center to form an elastic loop frictionally mounted in said eye, the two parts of the wire being twisted together



to form an arm extending from the eye and the ends of the wire being bent to form an elastic clamp at the end of the arm to encircle the neck of a lamp, and the extreme ends of the wire being crossed beyond the clamp to form handles for opening the clamp.

910,042. Motor-Controlling Device. Charles E. Carpenter, New York, N. Y., assignor to The Cutler-Hammer Mfg. Co., Milwaukee, Wis., a Corporation of Wisconsin. In a controller for electric motors, the combination with a pair of contacts, of an armature resistance connected thereto, a field regulating resistance, a controlling member therefor, a pair of contacts connected in a shunt circuit around said field resistance, an electromagnetic winding adapted to be connected across the



motor armature, a plunger mounted within said winding, a switch carried by said plunger, said switch being adapted when in one position to bridge one of said pairs of contacts and in another position to bridge the other of said pairs of contacts, and means for inserting a resistance in series with said electromagnetic winding after said switch has been actuated.

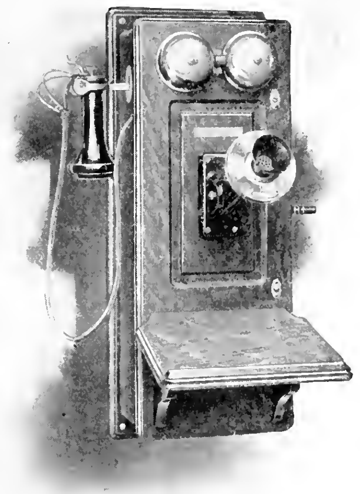
910,214. Commutator-Brush. Chester B. Mills, Wilmerding, Pa., assignor to Westinghouse Electric & Manufacturing Company. The combination with a carbon commutator-brush having a slotted outer edge, of a conducting strip located completely within the slot except at one end which is provided with a folded portion that projects at right angles to the commutator-engaging face of the brush, and a conductor clamped in the folded projection.

INDUSTRIAL

A NEW MAGNETO TELEPHONE SET.

The Western Electric magneto telephone set shown here marks a departure in this line. The changes introduced have resulted in making the set as a whole more efficient, the different parts more accessible for inspection and maintenance, and the outward appearance of the set more attractive.

Perhaps the most noticeable of these changes to the average telephone user is the absence of the line binding posts from the top of the set. In connection with this new feature, it is interesting to note that the practice of the Western Electric Company for years past has been to place the telephone protectors at the point where the line wires enter the building. All the inside wiring and the building itself are then protected. No provision has therefore been made to place the protector on the telephone sets, because the sets are seldom, if ever, installed at the point where the line wires enter the building. Moreover, a protector of the usual design when placed on the set introduces danger of personal injury and of fire on account of its proximity to the user and to inflammable material such as curtains; it is also liable to be tampered with and dust is apt to settle on it and ground the line.



Western Electric Magneto Telephone Set Showing Several New Improvements.

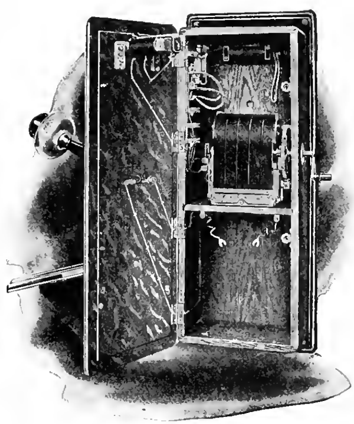
This practice of the Western Electric Company in placing their protectors at the point where the line wires enter the building rather than on the telephone set has enabled them to dispense with exposed binding posts on the telephone. The leading-in wires enter the set from the rear and this not only improves the outward appearance of the telephone set but prevents accidentally short-circuiting its main binding post.

The top of a wall telephone set is a most convenient spot to place articles and many a telephone set with exposed binding posts at the top has been temporarily put out of service by some metallic object being unknowingly placed between them. Obviously this would be impossible in the new telephone set illustrated herewith.

Accessibility to the working parts has been made a special feature in the design of the cabinet, in the mounting of the apparatus and in the left hand swing of the door. Opening the door toward the left facilitates inspection of the generator while turning its crank, a most important feature in time of need.

The hand generator has perhaps been developed to its highest stage of perfection in the five-bar generator included in this set. Comparative tests show it to be from 13 to 70 per cent more efficient under practical working conditions than other hand generators on the market, and it is guaranteed to ring the equivalent of forty 2500-ohm bells on a 30-mile full metallic line of No. 12 B. W. G. iron wire. The transmitter and receiver have the same high talking qualities for both local and long distance transmission as the transmitters and receivers supplied by the Western Electric Company to all telephone users.

The ringer is easy of adjustment and gives a loud, clear signal. The switch-hook is compact and self-contained.



Western Electric Magneto Telephone Set, Open.

Telephone sets of the description here noted are manufactured by the Western Electric Company for moderate and heavy load bridging service where code ringing is employed, whether with or without a condenser in the receiver circuit. The condenser insures the ringing of the bells even if a receiver is left off the hook.

Each set, as shown, is complete and ready for use with the exception of the dry cells; dry cells should, of course, be purchased as required in order to insure fresh cells being supplied.

The battery compartment is large enough to hold three standard size dry cells and Improved Blue Bell dry cells are specially recommended, they being specially designed for magneto telephone work.

TRADE NOTES.

The Simplex Electrical Company, of Boston, announces an arrangement just completed with the Telephone and Electric Equipment Company, of San Francisco, Seattle and Los Angeles, under which the latter Company is now in charge of their interests on the Pacific Coast.

The General Electric Company have issued Bulletin No 4638, which gives the arrangements, dimensions and connections of various styles of central station switchboards. It is of great assistance in designing switchboards for stations of moderate size and represents the latest practice in alternating current work.

NATIONAL CONDUIT AND CABLE COMPANY REOPENS IN SAN FRANCISCO.

The National Conduit and Cable Company, with which is affiliated the National Brass and Copper Tube Company of New York, opened offices and warehouse in the Bothin Building, 142-154 Second Street, San Francisco, under date of February 1st, from which point all their Pacific Coast business will be handled in the future.

They will carry in their San Francisco warehouse a complete stock of Bare and Weatherproof Wire, Brass Tubing, Steam Tube Fittings, and other products of their manufacture.

The management of this business will be in the hands of Mr. W. F. Hall, well and favorably known on the Pacific

Mr. W. F. Hall.

Coast through his connection during the past six years with the San Francisco office of the John A. Roebling's Sons Co.

Mr. Hall deserves to be looked upon as one of the pioneers of the electrical business on the Pacific Coast having located here in 1891, when in conjunction with Mr. T. E. Bibbins of the General Electric Company he located in Portland and opened the Supply Department of the Edison General Electric Company there. This addition to the electrical interests of the Coast is a welcome one and a further indication of the returning confidence of Eastern manufacturers.

NEW GAS MAKING COMPOUND.

Carl von Hartzfelt, M. C., of Wheeling, W. Va., an experimenter of considerable note on denatured alcohol from deoxidized natural gas by drip distillation, comes forward with a new compound which has great gas producing properties. He claims that their combination makes gas possible any where in quantities from a candle to be carried in the hand, to supplying cities at a cost of 20 cents per 1,000 cubic feet. He says the gas which is produced by the use of this compound is an extraordinarily strong and rich product.

This new gas producing compound is made from alkali and alkaline earth metal hydrides for the production of pure hydrogen gas, by means of natural gas, from calcium hydide.

Very rich hydrogen gas is evolved by means of denatured alcohol much as acetylene gas is evolved by means of water and calcium carbide. The gas made by this new compound can be used on automobiles, motor boats, etc., in place of gasoline with a gain of 25 per cent in speed with less expense.

REDWOOD CITY, CAL.—N. W. Halsey & Co. have been awarded the city bonds amounting to $20,000, at five and one-half per cent and running for 20 years, at a premium of $1,861.50. The money will be used for the improvement of the municipal water supply.

ROEBLING BUILDING.

The accompanying illustration shows the new home of the San Francisco office of the John A. Roebling's Sons Co., of which Mr. Squire V. Mooney is manager. It is on the corner of Folsom and Hawthorne streets and within the confines of the rapidly growing electrical district. The building is substantially built of reinforced concrete, and besides having the executive

Roebling Building.

and sales offices of the company, has ample space for the storage and handling of the large supply of weatherproof and bare copper wire carried in stock. It is as nearly fire-proof as a warehouse building can be made, having metal window and door frames, wire glass, water curtains and independent water supply. The architect in order to conceal the water tank, placed it in the cupola on the corner.

A NEW BRASS JOINT CEMENT.

The H. W. Johns-Manville Co., of New York, have recently placed on the market what is known as H-O Pipe Joint Cement. This cement is put up in powder form and can be kept in stock indefinitely, as it does not dry out or deteriorate. In using it, the cement is mixed with either water or linseed oil, making it ready for use. The chemical properties of H-O Cement are such that it expands after the joint is made up, thereby making a perfectly tight joint. It does not harden and the joint made with it can easily be broken at any time without danger of breaking the fittings. H-O Cement is not poisonous and does not taint water.

In figuring copper wire it is well to remember that in the B. & S. gage No. 10 wire is about 1-10 inch in diameter, has an area of about 10,000 circular mils, a resistance of 1 ohm per foot, and weighs about 32 pounds per thousand feet. A wire which is ten sizes larger than another has one-tenth its resistance, ten times its cross-sectional area and ten times its weight. An increase of 3 in the wire number doubles the resistance and halves the cross-section and weight.

NEWS NOTES

FINANCIAL.

SANTA BARBARA, CAL.—Bids will be received until February 18th for $40,000 of the $200,000 water extension bonds recently voted.

SAN FRANCISCO, CAL.—The Superior Court has awarded damages to James Dillon to the amount of $15,000 against the United Railroads.

BAKERSFIELD, CAL.—The Virginia Crude Oil Company has been incorporated here by H. M. Irelan, J. B. and Louise E. Wanney, all of Oakland.

MARTINEZ, CAL.—The Danville Water Company has been incorporated here with a capital stock of $6,000 by R. F. Booth, A. J. Abrott and A. G. Podca.

VISALIA, CAL.—The Lindsay Heights Water Company has levied an assessment of $3.50 per share on the capital stock, delinquent after February 23, 1909.

VISALIA, CAL.—The Visalia Midway Oil Company has levied an assessment of two mills per share on the capital stock, relinquent after February 23, 1909.

PASADENA, CAL.—An ordinance has been passed submitting to the voters of the city the proposition of issuing bonds to the amount of $150,000 for a municipal lighting plant.

SAN FRANCISCO, CAL.—The Alpha Oil Company has been incorporated here with a capital stock of $500,000 by B. J. Reilly, R. O. Hobson, F. H. Lathrop, G. H. Smith and L. J. Lathrop.

HANFORD, CAL.—The Azores Oil Company has been incorporated here with a capital stock of $3,500, by J. M. Robertson, M. J. Caetano, A. F. Nunes, S. M. Rosenberger and L. C. Dunham.

PHOENIX, ARIZONA — The remaining $60,000 of the Phoenix water works bonds have been sold to the Provident Savings Bank and Trust Company of Cincinnati, which paid a premium of $4,584, or more than 7½ per cent.

FRESNO, CAL.—The Coast Line Oil Company has been incorporated here with a capital stock of $300,000 by A. E. Wallace, of San Bernardino; G. J. Wells, Frank Hanson and G. M. Emerson, of Fresno, and C. K. McKenzie, of Los Angeles.

SACRAMENTO—A bill has been introduced in the Legislature providing for a tax on telephone companies of $1 for each pole in the state for the benefit of the various municipalities and for a state tax of five per cent on the gross income.

SALINAS, CAL.—The Tally-Ho Oil Company has been incorporated here with a capital stock of $500,000 by W. A. Conrad, Jr., E. C. Loomis, O. H. Perry, of Arroyo Grande; J. W. Stirling, of Oceano; C. T. Greenfield, of San Luis Obispo; F. E. Bedicheck, of Santa Maria, and R. C. Jensen of Guadalupe.

LOS ANGELES, CAL.—At the annual meeting of the stockholders of the Union Oil Company the report shows that the net earnings of the company have almost trebled. The net earnings for the year 1908 were $3,022,932.85. J. S. Torrance was elected second vice-president succeeding John Baker, who retired recently from the company and the directorate. Donzel Stoney of San Francisco succeeds Mr. Baker in the directorate.

OAKLAND, CAL.—The Oakland Light and Power Company has been incorporated with a capital stock of $1,250,000 by A. M. Hunt of Berkeley; J. K. Moffitt, Oakland; Mountford S. Wilson, San Francisco; Frederick G. Cartwright, San Francisco, and C. N. Beal, San Francisco. The company purposes to manufacture and furnish electric light and power and steam heat and power to the city of Oakland and to other cities and towns.

TRANSPORTATION.

ALTURAS, CAL.—B. F. Lynip and A. P. Cross have asked for a franchise to lay about 200 miles of railroad in Modoc County.

SAN DIEGO, CAL.—The Point Lome Railway has applied for a 20-year franchise to operate an electric street railway along certain streets.

PORTLAND, ORE.—The Portland, Baker City and Butte Electric Railroad Company has been incorporated at $2,000,000, to run from Portland to Baker City, across Idaho and Montana to Butte.

OGDEN, UTAH.—The Ogden Rapid Transit Company has instructed Joseph West, who is in charge of the construction work of the trolley line through Ogden Canyon, to push the work with all possible speed. As a result Mr. West has called for bids for four miles of grading.

EUGENE, ORE.—The Lane County Asset Company has secured a franchise for a line from Eugene to Florence. F. Thomas, Alton Hampton, F. E. Dunn, C. H. Fisher, Fred Fisk, F. M. Johnson, J. Rodman, George M. Miller, A. F. Campbell and Joseph Fellman of Eugene, are interested.

LOS ANGELES, CAL.—The Pacific Electric Railway Company has been granted a franchise to connect the main tracks of its line with the Long Beach extension. The franchise was asked for over a year ago, but was held up till the company consented to collect only a five cent fare within the city limits.

WALLA WALLA, WASH.—Contracts will be let about March 1st for the construction of the proposed seventy-mile line by the Walla Walla and Columbia Traction Company. The proposed road is to run from Dayton to Huntsville, Wartsbury and Walla Walla. N. G. Blalock, Walla Walla, Wash., is president.

SEATTLE, WASH.—W. R. Clarke, President of the United States Trust Company, Kansas City, Mo., is at the head of a new syndicate which will finance the Seattle, Tacoma Short Line. Construction work will begin as soon as details are arranged and it is expected to have the line ready for operation by June 10, 1909.

SAN FRANCISCO, CAL.—Frank D. Stingham, representing himself and others, has applied to the Board of Supervisors for a franchise for a street car system along and under Stockton street from Market to the North Beach. According to the plans given out, the road will tunnel under Stockton street from Sutter to Sacramento street, a distance of four blocks. If the franchise is granted as petitioned for, a com-

PASADENA, CAL.—The Pasadena Rapid Transit Company has taken over the old Cycleway Company, and in that way secured right-of-way between Pasadena and Los Angeles. It is expected that actual construction work will be started in the spring. The road will be over a private right-of-way and will be double-track and standard gauge. Horace H. Dobbins, Los Angeles, Cal., is president. Don Porter, Pasadena, Cal., is also interested.

SANTA BARBARA, CAL.—A franchise has been granted to the Santa Barbara Consolidated Railroad Company for an electric street railway along Bath street from the southerly line of its intersection with Second street, to the center of intersection of Bath and Fourth streets.

FRESNO, CAL.—Manager A. G. Wishon, of the Fresno Traction Company, states that the extension work on the railway lines of this city is progressing favorably. General Manager Balsh came from Los Angeles, where his offices are located, this week for the purpose of looking over the local situation.

SAN FRANCISCO, CAL.—Four condemnation suits have been filed here by the California Company for rights of way near Napa Junction. The company which plans to build a railroad from Sacramento through Yolo, Solano, Napa and Marin counties to San Francisco, was incorporated last September with a capital stock of $2,000,000.

CHEHALIS, WASH.—The Twin City Light and Traction Company has been organized by A. Welch and W. J. Paterson of Portland and C. L. McKenzie of Colfax. Capital stock is $100,000 and the object of the incorporation is building and operating an electric line between Chehalis and Centralia and furnishing light and power to the two cities.

WALLACE, IDAHO.—Project for an electric railway between Wallace and Coeur d'Alene has been revived. W. J. Hall, Chief Accountant of the Federal Mining and Smelting Company, who has the franchise, has asked for re-enactment of the city ordinance giving the company right to enter Wallace. About $20,000 has been spent in securing right-of-way and making surveys.

HONOLULU, H. I.—The Pearl Harbor Traction Company, a subsidiary company to the Honolulu Rapid Transit Company, has applied for a charter. The traction company proposes to extend the lines of the Rapid Transit Company to the Naval Station at Puulea, Pearl Harbor. The company is capitalized at $100,000, with the privilege of increasing this amount to $5,000,000. The officers are L. Tenny Peck, president, and Charles H. Atherton, treasurer. Other shareholders are C. Ballentyne, W. B. Castle, F. W. Klebahn and D. L. Winchinton.

pany to be called the Stockton Tunnel and Railway Company, or some similar name will be incorporated with a capitalization of $1,000,000. The tunnel is to be of reinforced concrete, 22 feet wide by 22 feet high, and will cost about $115,000. Negotiations are being made with the Presidio and Ferries Railway Company for transfer arrangements which will open the entire Presidio district to the central portion of the city. The petition states that the cars are to be operated by electricity supplied by an overhead trolley or by gasoline or compressed air. The life of the franchise is to be twenty years.

ILLUMINATION.

PETALUMA, CAL.—The city charter is to be amended so as to permit of the acquiring of a municipal gas plant.

HEALDSBURG, CAL.—The city authorities have asked for bids for an addition to be made to the power house on the Gird Ranch.

LEWISTON, IDAHO.—G. H. Burke of the Cook-Clarke Company, Spokane, has been granted a franchise to establish an electric light system in this place.

HEMET, CAL.—R. J. Penn, president of the Hemit-San Jacinto Gas Company, who is now here, states that he has decided on making a number of improvements to the plant.

FRIDAY HARBOR, WASH.—Robert Moran has applied for a franchise to use all of the county roads, streets, etc., on Orcas Island for the construction and maintenance of water works and electric light lines.

SAN DIEGO, CAL.—It has been practically decided to light D street from California to Eighth street with ornamental electric lights on ornamental poles. The conduits for the necessary wires are to be laid before the street is paved.

SACRAMENTO, CAL.—A bill has been introduced into the State Legislature providing for the placing of a telephone system and an electric lighting plant in the California State hospital at Stockton. The two plants are to cost about $35,000.

SAUSALITO, CAL.—The Marin County Gas Company is having trouble securing the desired franchise here. The trouble is due to the fact that the company neglected to deposit $100 with the town officials to cover the cost of advertising for bids for the franchise.

OIL.

BAKERSFIELD, CAL.—At a recent meeting of the Independent Producers Agency, President L. P. St. Clair was authorized by the Board of Directors to agree upon a contract of sale for the output of the Association to take effect as soon as the present contract of sale expires, which will be in about a year. This delegation of power into the hands of a single individual was due in part to the general belief among the directors that under all the conditions wiser and more profitable action would result in this way than if action were attempted by the whole Board participating. It was also decided at the directors meeting to establish a statistical bureau for the gathering of information respecting the condition of oil both the marketing and the producing ends. During the past year the following companies have become associated with this agency: Akron Oil Company, American Crude Oil Company, C. J. Oil Company, Cousins Oil Company, Clearmont Oil Company, Calloma Extension, Emerald, E. P. T. Company, Fox and Garrett, Junction, Jewett, Los Angeles-Kern, McCutcheon Brothers, McKittrick, Merrill and Benedict, Kern, McCutcheon Brothers, McKittrick, Merrill and Benedict, M. & S. Oil Company, Olig Crude, Only, Rambler, Ruby, Silver Bow, St. Clair and Jastro, Tejon, Walker and Heck, United Crude, and New Center.

WATER.

LOS ANGELES, CAL.—The San Bernardino Water Commission has awarded the contract for a new well to augment the city's water supply to H. F. Gansner of this city. The well is to cost upwards of $5,900.

SAN FRANCISCO, CAL.—The question of a "Bay Cities Water District" is receiving some attention here and it is expected that if a satisfactory plan can be evolved some action providing for the formation of such a district will be taken by the present Legislature.

PHOENIX, ARIZONA.—The bid of Mr. Jaeger, representing the American Light and Power Company, of Kansas City, Mo., was the lowest submitted for the construction of the proposed municipal waterworks system, and the contract will be awarded to him when the necessary formalities are completed. Mr. Jaeger's bid was $15,590.

TRANSMISSION.

SONORA, CAL.—Drenzy A. Jones has asked for the use of 20,000 inches of water from the Main Tuolumne river at a point to be determined later for power and other purposes.

TRADE MARKS

assified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer — who will listen with a willing and eager ear to the story of quality.
Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

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ec. Appliance Co., "Eaco."
lerulff, B. F., Jr. & Co., "Sterling."
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INDEX TO ADVERTISEMENTS

ASBESTOS

ohns-Manville Co., H. W.

BATTERIES

DRY BATTERIES

)ean Electric Co.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
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Stanley & Patterson, Inc., "Exeter," "Matchless."
Vestern Electric Co., "Blue Bell," "Liberty."

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Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES

'artrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

)PEN AND CLOSED CIRCUIT WET BATTERY

Elec. Goods Mfg. Co., "Samson," "Noswas."
'artrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Vestern Electric Co.

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Vestghse Machine Co.

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tanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
/estern Electric Co., "Hawthorne."

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arshall Elec. Co.
artrick, Carter & Wilkins Co.

MAGNETO BELLS

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lec. Appliance Co., "Eaco."
lectric Goods Mfg. Co.
lerulff, B. F., Jr. & Co., "Sterling."
ellogg Sw'b'd & Supply Co.
andard Elec. Wks., "C & S"
/estern Electric Co.

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eystone Boiler Wks., "Parker."
oore & Co., Chas. C., "B. & W."
andard Electrical Works, "Robb-Mumford."
racy Engineering Company, "Edge Moor."

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ossert Electric Const. Co., "Bossert."
hase-Shawmut Co., "Knockout."
hicago Fuse Wire & Mfg. Co., "Union."
ole Co., John R., "Bossert."
utter Co., The, "Munit."
ec. Appliance Co., "T & B"
eneral Electric Co.
arvard Elec. Co.
olabird-Reynolds Elec. Co.
arshall Electric Co.
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FOR SALE, WANTED

And Other Classified Advertisements

The rate for advertisements in this column is \$1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the JOURNAL OF ELECTRICITY POWER AND GAS, 604 Mission Street, San Francisco.

WANTED—Back numbers of the JOURNAL OF ELECTRICITY, POWER AND GAS. We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.
JOURNAL OF ELECTRICITY, POWER AND GAS,
604 Mission Street, San Francisco.

SITUATION WANTED—By electrical engineer with 15 years' experience in designing and estimating of electric power plants, switch gears, light, motor and storage battery installations; also in central station service. Advertiser takes also draughting work in this line as home occupation if no steady engagement can be attained. Moderate expectations. Address Box 101, Journal of Electricity, San Francisco.

AGENTS WANTED on a guaranteed weekly salary to represent our two publications, "Southern Engineer" and "Southern Machinery"; liberal terms for exclusive services; easy sellers; every engineer and every machinist is interested. Write at once. For further information, address W. R. SMITH PUB. CO., Sub. Dept., Atlanta, Georgia.

POSITION WANTED by an experienced electrician with some business ability. First-class references on this Coast. Will accept low salary if opportunity for advancement. Address Box 102, Journal of Electricity.

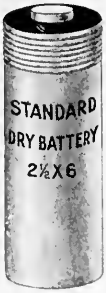
FOR SALE at bargain prices: Two 6-wide, 9-high, 18 ft. Babcock & Wilcox wrought iron front boilers in first-class condition. For particulars, see B. W. RICE, 1419 Metropolis Bank Building, San Francisco.

JOHN R. COLE COMPANY

PATTERSON WIRELESS DRY BATTERY HOLDER

"You screw the battery in — we've done the rest"

(Battery renewals like lamp renewals)



A REVOLUTION IN BATTERY WORK

¶ Wireless Battery Holders must win the commendation of every **up-to-date** contractor, for they make the hitherto unsightly, unsatisfactory battery set **ideal.**

¶ Strips screw up against beams of cellar or against side wall, as desired.

¶ Automatic bridge for each cell, so an exhausted battery can be taken out without interrupting circuit. **Send for Bulletin**

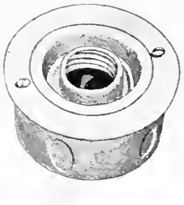
STANLEY & PATTERSON, Inc.
23 Murray St. New York

The Fiercest Competition

causes very little uneasiness to the man who offers first-class conduit work at reasonable prices because he figures on the use of

Bossert Drawn Steel Boxes

when he estimates. There are hundreds of such men all over the country, who are always busy with profitable work. Get in line! See for yourself how we make one sharp hammer blow do the work of drill, file and reamer, and how any live contractor can get a living out of his business. The sample tells the story. Shall we send it?



Bossert Electric Construction Co.
UTICA, N. Y.

TAPE

Is a small item with the purchasing agent, but small items sometimes cause large and expensive troubles.

GRIMSHAW and COMPETITION TAPE

are **good** in **quality** and must be used to be appreciated

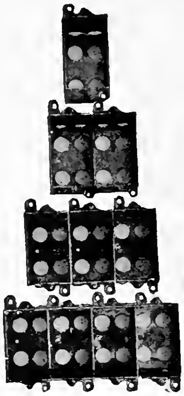
Write us direct, if your supply house does not carry it in stock

Prompt Shipments

New York Insulated Wire Co.
114 Liberty St., New York

"MUNIT" Wall Boxes

For Improved C-S Switches



The unit idea, which has proven such a success in the standardization of switchboards, forms the basis of our system of steel wall boxes.

Each box is complete in itself, there being four holes in the back of each box, two holes in the top and two holes in the bottom. These holes are filled with heavy steel buttons, one or more of which may readily be removed by a slight blow of the hammer. **The demand for this box is constantly increasing for the reason that it is the best and cheapest box on the market.**

The Cutter Company
PHILADELPHIA, PA.

766-770 FOLSOM STREET SAN FRANCISCO
SEATTLE · PACIFIC COAST REPRESENTATIVES LOS ANGELES

BRACKETS

CEILING BRACKET AN
DESK FIXTURES
Stanley & Patterson, Inc
"Sunlight."

DESK TELEPHONE
BRACKETS
Stanley & Patterson, Inc
"Imperial."
Sterling Elec. Co. "Equ
poise.
Western Electric Co.

IRON POLE BRACKETS
Benicia Iron Works.
Elec. Appliance Co., "Cutter
Kierulff, B. F., Jr. & Co
"Cutter."
Pierson, Roeding & Co.
Western Elec. Co. "Fletcher

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ELECTRIC GAS LIGHTIN
BURNERS
Electric Goods Mfg. Co., "Ad
vance."
Edwards & Co.
Welsbach Company.
Western Electric Co., "Ed
wards."

CABLES

SUBMARINE AND LEAD
COVERED
American Electrical Works.
Belden Manufacturing Co.
Electric Appliance Co., "Pa
anite."
General Electric Co.
Habirshaw Wire Co., "Ha
irshaw."
Kierulff, B. F., Jr. & Co
"National."
National Conduit & Cable Co
"National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A
"Tolma."
Safety Ins. Wire & Cable C
Standard Electrical Work
"Simplex."
Standard Underground Cab
Co.
Simplex Electrical Co., "Sim
plex."
Western Electric Co., "Haw
thorne."

PAPER INSULATION
Belden Manufacturing Co.
Nat'l. Conduit & Cable Co.
Western Electric Co.

TELEPHONE CABLE
Dean Electric Co.

CARBONS

ARC LIGHT CARBONS
Brooks-Follis, Elec. Corp
he, "Siemens."
Reisinger, Hugo, "Electra
"Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The, "I-T-E
"Dalite."
Ft. Wayne Electric Works
General Electric Co.
Kierulff, Jr., & Co., B.
"Hartman."
Western Elec. Co., "I-T-E
"Dalite."
Westghse Elec. & Mfg. Co

CLEATS

FIBRE CLEATS
Blake Signal & Mfg. Co.
PORCELAIN CLEATS
General Electric Co.
Holabird-Reynolds Elec. C
"Electric Porcelain."
Thomas & Sons Co., R.
Weber Elec. Co., H. D. Sea
general sales agent.
Western Elec. Co., "Thoma
WOOD KNOBS
Blake Signal & Mfg. Co.

CLUSTERS

FIXTURE CLUSTERS
Benjamin Electric Mfg. C
"Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbe

COILS

ARMATURE AND FIELD COILS

ielden Manufacturing Co.
ieneral Electric Co.
Vestern Electric Co., "Delta-beston."
Vestghse Elec. & Mfg. Co.

INDUCTION COILS

lectric Goods Mfg. Co.
artrick,Carter & Wilkins Co.
Vestern Electric Co.

SPARK COILS

merican Electrical Works.
lectric Goods Mfg. Co.
Vestern Electric Co.

COMPOUNDS

BOILER COMPOUNDS

earborn Drug & Chemical Works.
ohns-Manville Co., H. W., "Magic."

CONDUIT

FLEXIBLE CONDUIT

merican Circular Loom Co., "Circular Loom."
ole Co., John R., "Circular Loom."

RIGID CONDUIT

merican Circular Loom Co., "Electroduct."
lec. Appliance Co., "Galvaduct," "Loricated."
ierulff, B. F., Jr. & Co., "American."
oeblings Sons Co., J. A. "Navalite."
ole Co., John R., "Electroduct."

UNDERGROUND CONDUIT

ohns-Manville Co., H. W., "J.-M."
ierson, Roeding & Co., "Fibre."
oeblings Sons Co., J. A., "Bituminized Fiber."
Valworth & Neville Mfg. Co.
Vestern Electric Co., Agents Walworth & Neville Mfg. Co.

CONNECTORS

CABLE CONNECTORS

elden Manufacturing Co.
hicago Fuse Wire & Mfg. Co.
larvard Elec. Co.
ierulff, B. F., Jr. & Co.

CORD

FLEXIBLE BELL CORD

merican Electrical Works.
elden Manufacturing Co.
eneral Electric Co.
Kierulff, B. F. Jr. & Co., "National."
ierson, Roeding & Co., Agts, Elec. Cable Co.
oebling Sons Co., John A.
implex Elec. Co.
Vestern Electric Co.

LAMP CORD

merican Electrical Works.
elden Mfg. Co.
lec. Appliance Co., "Paranite."
eneral Electric Co.
konite Co., The, "Okonite."
ierson, Roeding & Co., Agts. Elec. Cable Co.
oeblings Sons Co., John A.
afety Ins. Wire & Cable Co.
implex Elec. Co.
td. Elec. Wks., "Simplex."
tandard Und. Cable Co.
Vestern Elec. Co., "Victor."

TELEPHONE CORD

elden Manufacturing Co.
ean Electric Co.
ellogg Sw'b'd & Supply Co.
ierulff, B. F., Jr. & Co. "National."
ierson, Roeding & Co., Agts. Elec. Cable Co.
afety Ins. Wire & Cable Co.
implex Elec. Co.
tandard Elec. Works, "Simplex."
Vestern Elec. Co., "Victor."

CROSS ARM BRACES

Benicia Iron Works.
Kierulff, B. F., Jr. & Co.

CUT-OUTS

ARC CUT-OUTS

Bryant Electric Co.
Ft. Wayne Electric Work
General Electric Co.
Perkins Elec. Switch Mfg.
Westghse Elec. & Mfg. C

INCANDESCENT CUT-OUTS

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg
Weber Elec. Co., H. D. Se general sales agent.
Westghse Elec. & Mfg. C

TRANSFORMER CUT-OUTS

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
Perkins Elec. Switch Mfg
Westghse Elec. & Mfg. C

DYNAMOS

ALTERNATING CURRENT DYNAMOS

Allis-Chalmers Co.,"Bullo
Fairbanks, Morse & Co.
Ft. Wayne Electric Work
General Electric Co.
Standard Electrical W "E. M. Co."
Western Electric Co.
Westghse Elec. & Mfg. C

DIRECT CURRENT DYNAMOS

Allis-Chalmers Co.,"Bullo
Electric Appliance Co., " onial."
Fairbanks, Morse & Co.
Ft. Wayne Electric Wor
General Electric Co.
Northern Electrical Mfg
Standard Electrical W "E. M. Co."
Western Electric Co.
Westghse Elec. & Mfg. C

ELEVATORS

Van Emon Elevator Co.

ENGINES

GAS AND GASOLINE ENGINES

Allis-Chalmers Co.
Moore & Co., Chas. C.
Fairbanks, Morse & Co.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Wes house."
Kierulff, B. F., Jr. & "American Diesel Eng
Tracy Engineering Co.
Westghse Machine Co.

MARINE ENGINES

Standard Elec. Works, " bery."

STEAM ENGINES

Allis-Chalmers Co.
Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Wes house."
Tracy Engineering Co., T
Westghse Machine Co.

FANS

DESK AND BRACK ALTERNATING CURRENT FANS

Ft. Wayne Electrical W
General Electric Co., "G
Standard Electrical W "Jandus."
Western Elec. Co., "Vic "Emerson."
Westghse Elec. & Mfg.

EXHAUST FANS

General Electric Co.
Standard Elec. Wks., "I Co."
Wagner Electric Mfg. C
Western Elec. Co., "W.
Westghse Elec. & Mfg.

CEILING, ALTERNAT CURRENT FANS

Standard Elec. Wks., " dus." "Century."

tern Elec. Co., "Victor," merson."
tghse Elec. & Mfg. Co.

ILING, DIRECT CURRENT FANS

tric Appliance Co., "Colial."
dard Elec. Wks., "Jans."
tern Electric Co., "Hawthorne."
tghse Elec. & Mfg. Co.

ESK AND BRACKET ECT CURRENT FANS

tric Appliance Co., "Colial."
Wayne Electric Works.
eral Electric Co., "G. E."
dard Electrical Works, andus."
tern Electric Co., "Hawthorne."
tghse Elec. & Mfg. Co.

FIXTURES

LING, BRACKET AND DESK FIXTURES

jamin Electric Mfg. Co.
Co.

MARINE FIXTURES

jamin Electric Mfg. Co.
Co.
tric Appliance Co.
ling Electric Co.

SOW CASE FIXTURES

jamin Electric Mfg. Co.
Co.
s-Manville Co., H. W., inolite."

STAGE FIXTURES

se-Shawmut Co., "Shawmut."

FUSE MATERIAL

CLOSED FUSES AND FITTINGS

nt Electric Co.
se-Shawmut Co., "Shawmut."
ago Fuse Wire Mfg. Co., nion."
W. Fuse Co.
eral Electric Co.
s-Manville Co., H. W., oark."
shall Electric Co.
ins Elec. Switch Mfg. Co.
tern Elec. Co., "D. & W."
tghse Elec. & Mfg. Co.

FUSE BOXES

ding Service Boxes, Suby Boxes and Junction t Outs for use with ensed fuses.
W. Fuse Co., "D. & W."
s-Manville Co., H. W., oark."

FSE WIRE AND LINKS

se-Shawmut Co., "Shawmut."
ago Fuse Wire & Mfg.
eral Electric Co.
vard Electric Co.
& Seymour.
son, Roeding & Co., "Alunum."

CELLANEOUS FUSES

ant Electric Co.
vard Electric Co.
shall Electric Co.
ins Elec. Switch Mfg.
er Elec. Co., H. D. Sears n'l Sales Agt.

ELEPHONE FUSES

n Electric Co.
W. Fuse Co.
ulff, B. F. Jr. & Co., Sterling."
dard Elec. Wks., "Couch Seeley."
tern Electric Co.

GOVERNORS

WATER-WHEEL GOVERNORS

son, Roeding & Co., ombard."

GUARDS

WIRE LAMP GUARD

Benjamin Electric Mfg. "Can't Break," "Prote lite."
General Electric Co.
Harvard Electric Co.
Hubbell, Harvey.
Welsbach Company.

HANGERS

CABLE HANGERS

Chase-Shawmut Co., "I ton."
Kierulff, B. F. Jr. & "National."
Standard Underground C. Co., "Nordyke Support."
Harvard Electric Co.

HEATING MATERIAL

Including Cooking Uten Soldering Irons, Sad Ir Etc.
Elec. Appliance Co., "Am can."
General Electric Co.
Johns-Manville Co., H. "Electrotherm."
Simplex Elec. Heating "Simplex."
Standard Elec. Wks., "S plex."
Vulcan Electric Heating "Vulcan."
Westghse Elec. & Mfg. C

HOODS

STREET HOODS AN FIXTURES

Elec. Appliance Co., "Cutt
Ft. Wayne Elec. Works.
General Electric Co.
Kierulff, B. F., Jr. & "Cutter."
Western Elec. Co, "Fletc

INSULATORS

GLASS INSULATOR

Brookfield Glass Comp "Brookfield."
Elec. Appliance Co., "H ingray."
Pierson Roeding & Comp "Locke Triple Petticoa
Roeblings Sons Co., John "Knowles."
Western Elec. Co., "Br field."

HIGH-TENSION INSULATORS

Roeblings Sons Co., John "Lima."
Kierulff, B. F., Jr. & "Ohio Brass."
Pacific Elect'l Works, " Lexington."
Pass & Seymour.
Pierson, Roeding & Comp "Locke."
Thomas & Sons Co., R.
Western Elec. Co., "Thon

PORCELAIN INSULATORS

General Electric Co.
Holabird-Reynolds Elec. "Electric Porcelain."
Pass & Seymour.
Pierson, Roeding & Comp "Locke."
Thomas & Sons Co., R.
Weber Electric Co., H. Sears, general sales ag
Western Elec. Co., "Thon

INSULATING MATERIA

Belden Manufacturing Co
Holabird-Reynolds Elec. "Sterling" Varnish.
Johns-Manville Co., H. W "Asbestos Wood," "Ir rated Fibre," "Vulca ton," "Monarch," "Pl nix," "Electrobeston."
Kierulff, B. F., Jr. & "Di-electric."
Paraffine Paint Co., Ag "P. & B." Products.
Standard Underground C Co., "Ozite."

LAMPS

ELECTRIC ARC LAMPS

Elec. Appliance Co., "Adams-Bagnall."
Ft. Wayne Electric Works, "Wood."
General Electric Co., "G. E."
Standard Electrical Works, "Jandus," "Boulevard."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

FLAMING ARC LAMPS

General Electric Co., "G. I."
Western Elec. Co., "Beck."
Westghse Elec. & Mfg. Co.

GAS ARC LAMPS

Welsbach Company.

INCANDESCENT LAMPS

Brooks-Follis Elec. Corp., "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co., "California."
Columbia Inc. Lamp Co., "Columbia."
Elec. Appliance Co., "Packard."
Fairbanks, Morse & Company "Fairbanks-Morse."
General Elec. Co., "Edison," "Lowatt."
Holabird-Reynolds Elec. Co., "Femco."
Kierulff, B. F., Jr. & Co., "Excelsior."
Johns-Manville Co., H. W., "Linolite."
Pacific Electrical Wks., "Columbia."
Standard Electrical Works, "Improved California."
Sterling Elec. Co., "Sterling."
Sunbeam Inc. Lamp Co., "Sunbeam," "Regal."
Western Electric Co., "Sunbeam," "Regal."
Westghse Elec. & Mfg. Co., "Westinghouse."

TANTALUM LAMPS

Bryan-Marsh Co., "Imperial."
Columbia Inc. Lamp Co., "Columbia."
General Elec. Co., "Meridian Tantalum."
Kierulff, B. F. Jr. & Co., "Excelsior."
Holabird-Reynolds Elec. Co., "Femco."
Sunbeam Inc. Lamp Co., "Sunbeam."
Western Electric Co., "Sunbeam."

TUNGSTEN LAMPS

Bryan-Marsh Co., "Imperial."
Brooks-Follis Elec. Corp., "Fostoria."
California Inc. Lamp Co., "California."
Columbia Inc. Lamp Co., "Columbia."
Elec. Appliance Co., "Packard."
General Electric Co.
Kierulff, B. F. Jr. & Co., "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc. Lamp Co., "Sunbeam."
Western Electric Co., "Sunbeam."
Westghse Elec. & Mfg. Co.

LINE MATERIAL

STREET RAILWAY LINE MATERIAL

General Electric Co.
Johns-Manville Co., H. W., "J.-M."
Kierulff, B. F., Jr. & Co., "Lord Electric Co."
Pass & Seymour.
Pierson, Roeding & Co, "Ohio Brass Co."
Western Electric Co., "Electrose."
Westghse Elec. & Mfg. Co.

MACHINES

REFRIGERATING MACHINES

Vulcan Iron Works.

MINING

MINING MACHINERY

General Electric Co.
Henshaw-Bulkley & Co.
Moore & Co., Chas. C.
Westghse Elec. & Mfg. Co.
Western Electric Co.

METERS

AMMETERS AND VOLTMETERS

General Electric Co.
Johns-Manville Co., H. W., "Victor Combination."
Ft. Wayne Elec. Works, "Wood."
Wagner Elec. Mfg. Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.
Weston Elec. Instmt. Co.

WATTMETERS

Duncan Elec. Mfg. Company, "Duncan," "Monetary."
Electric Appliance Co., "Sangamo."
Ft. Wayne Electric Works.
General Electric Co.
Johns-Manville Co., H. W.
Wagner Elec. Mfg. Co.
Weston Elec. Instmt. Co.
Westghse Elec. & Mfg. Co.

MOTORS

ALTERNATING CURRENT MOTORS

Allis-Chalmers Co.
Fairbanks, Morse & Co.
General Electric Co.
Kierulff, Jr., & Co., B. F., "Ideal."
Standard Elect'l Wks., "Century."
Western Electric Co.
Westghse Elec. & Mfg. Co.

DIRECT CURRENT MOTORS

Elec. Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co.
Fairbanks, Morse & Co.
Standard Electrical Works, "Century."
Northern Electrical Mfg. Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

MOULDING

American Circular Loom Co., "Lutz."
Johns-Manville Co., H. W., "Electrobestos."

PHOTOGRAPHERS

Waters & Co., R. J.

PAINTS

INSULATING PAINT

Keirulff, B. F., Jr. & Co., "Di-electric."
Paraffine Paint Co., The "P. & B."
Standard Underground Cable Co., "Ozite."

PINS

IRON PINS

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Harvard Elec. Co.
Kierulff, B. F., Jr. & Co., "Hubbard."
Pierson, Roeding & Company, "Locke."
Roeblings & Sons Co., J. A., "Lima."
Thomas & Sons Co., The R., "Lee."
Western Elec. Co., "Lee," "Fletcher."

WOOD PINS

Kierulff, B. F., Jr. & Co.
Pierson, Roeding & Company, Eucalyptus and Locust.

PIPE

IRON AND STEEL PIPE

The Shaw-Batcher Co.

PLUGS

ATTACHMENT PLUGS

Benjamin Elec. & Mfg. Co., "Wizard."
Bryant Electric Co.
Electric Goods Mfg. Co., "Howes."
General Electric Co.
Hubbell, Harvey.
Marshall Elec. Co.
Pass & Seymour.
Perkins' Elec. Sw. Mfg. Co.
Stanley & Patterson, Inc., "New Code."

FLUSH PLUGS AND RECEPTACLES

Bryant Electric Co., "Chapman."
Cutter Co., The
General Electric Co.
Hubbell, Harvey.
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.
Stanley & Patterson, Inc., "Simplex."

STAGE PLUGS AND RECEPTACLES

Chase-Shawmut Co., "Cushing."
General Electric Co.
Stanley & Patterson, Inc., "Fielding."
Western Elec. Co, "Krueger"

POLES

IRON AND STEEL POLES

California Pole & Piling Co.
Benicia Iron Works.
Kierulff, B. F. Jr. & Co., "Tripartite."
Pierson, Roeding & Co.

WOOD POLES

California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Sterling Elec. Co.
Western Electric Co.

PUSH BUTTONS

Edwards & Co.
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co
Pass & Seymour.
Western Electric Co., "Edwards," "Midget, Jr.," "New Mite."

RAIL BONDS

Chase-Shawmut Co., "Shawmut."
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Thomas."
Nat'l Conduit & Cable Co.
Pierson, Roeding & Co.
Roeblings Sons Co., J. A.
Westghse Elec. & Mfg. Co.

RECTIFIERS

General Elec. Co., "Mercury Arc."
Westghse Elec. & Mfg. Co., "Cooper-Hewitt."

RHEOSTATS

FIELD RHEOSTATS

Cutler-Hammer Mfg. Co.
Ft. Wayne Elec. Works.
General Elec. Co.
Simplex Elec. Heating Co.

MOTOR STARTERS AND CONTROLLERS

Cutler-Hammer Mfg. Co.
Ft. Wayne Elec. Wks.
General Elec. Co.
Westghse Elec. & Mfg. Co.

SEARCHLIGHTS

Ft. Wayne Elec. Works.
General Elec. Co.
Std. Elec. Wks., "Engberg."

SHADES

Benjamin Elec. & Mfg. Co., Metal.
Dale Co.
Elec. Appliance Co., "Cutter."
Holophane Co.
Hubbell, Harvey.
Pass & Seymour.
Western Electric Co., "Marten."

SOCKETS

Including all classes of Sockets and Receptacles.
Benjamin Elec. & Mfg. Co., "Twin" Socket, "Benco" W. P. Socket.
Bryant Elec. Co., "Bryant."
Cutler-Hammer Mfg. Co.
General Elec. Co., "Edison."
Holabird-Reynolds Elec. Co., "Weber."
Hubbell, Harvey, "Hubbell Pull Socket."
Johns-Manville Co., H. W., Moulded Mica W. P. Sockets.
Marshall Elec. Co., "M.-S."
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.
Stanley & Patterson, Inc., "New Code" W. P.
Weber Electric Co., H. D. Sears general sales agent.

SOLDERING MATERIAL

SELF-FLUXING SOLDER

Belden Manufacturing Co.
Dean Electric Co.—"1900."
Kellogg Sw'b'd & Supply Co.
Kierulff, B. F., Jr. & Co., "Di-electric."
Western Electric Co.

SOLDERING PASTE

Belden Manufacturing Co.
Blake Signal & Mfg. Co., "Aluminum Tube."
Chase-Shawmut Co., "Red E."
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F. Jr. & Co., "Dielectric."
Standard Electrical Works, "Standard."
Western Elec. Co., "Hawthorne."

SOLDERING SALTS

Belden Manufacturing Co.
Western Elec. Co., "Hawthorne."

SOLDERING STICKS

Belden Manufacturing Co.
Western Electric Co.," Hawthorne."

STREET CARS

Pierson, Roeding & Co., "Brill."

STAPLES

INSULATING STAPLES

Blake Signal & Mfg. Co.
Kierulff, B. F., Jr. & Co., "Blake."

SUPPLIES

Concentrate your Accounts and Shipments

The following Advertisers carry a general stock of electrical supplies.

Brooks-Follis Elec. Corpn.
Electric Appliance Co.
Holabird-Reynolds Elec. Co.
Pacific Electrical Works.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

SWITCHES

DOOR SWITCHES

Bryant Elec. Co., "Perkins."
Edwards & Co., "Eco," "Lungen."
Marshall Elec. Co., "M.-S."
Perkins Elec. Switch Mfg. Co.
Standard Electrical Works, "M. & M."
Western Elec. Co., "Eco," "Lungen."

FLUSH AND SNAP SWITCHES

Arrow Elec. Co., "Arrow E."
Bryant Elec. Co., "Perkins."
Cutler-Hammer Mfg. Co.
Dale Co.
General Electric Co.
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co
Standard Electrical Works. "M. & M."
Cutter Co., The. "C-S"

KNIFE SWITCHES

Chase-Shawmut Co.
General Electric Co.
Holabird-Reynolds Elec. Co
Marshall Elec. Co., "M-S."
Perkins Elec. Switch Mfg. Co.
Std. Elec. Wks., "Barkelew"
Western Electric Co.
Westghse Elec. & Mfg. Co.

PENDANT SWITCHES

General Elec. Co.
Pass & Seymour.
Perkins Elec. Sw. Mfg. Co.

SWITCHBOARDS

LIGHT AND POWER BOARDS

Cutter Co., The,
Fairbanks, Morse & Co.
Ft. Wayne Elec. Works.
General Electric Co.
Standard Electrical W
"Barkelew."
Western Electric Co.
Westghse Elec. & Mfg.

TELEPHONE BOAR

Dean Elec. Co.
Elec. Appliance Co., "E
Elec. Goods Mfg. Co.,
nunciaphone," "Roto
Kierulff, B. F. Jr. &
"Sterling."
Kellogg Sw'b'd & Suppl
Standard Electrical W
"Couch & Seeley."
Western Electric Co.

TAPE

American Electrical W
Belden Manufacturing C
"Century."
Elec. Appliance Co., "E
General Elec. Co., "Para
Johns-Manville Co., H
"Magnetto," "Fibr
"Niagrite," "J.-M."
Kierulff, B. F. Jr. &
"Imperial."
N. Y. Insulated Wire
"Grimshaw," "Com
tion."
Okonite Co., The, "Oko
"Manson."
Paraffine Paint Co., The
& B."
Sterling Elec. Co., "E
"Sequoia."
Western Elec. Co., "Vi
"Amazon."

TELEPHONE EQUIPM

Dean Electric Co.
Electric Appliance Co.
Electric Goods Mfg. Co
Kellogg Sw'b'd & Suppl
Kierulff, B. F., Jr. &
"Sterling."
Western Elec. Co.

TOOLS

CONSTRUCTION TO

Kierulff, B. F., Jr. & Co
Klein & Sons, Mathias

WIRE-CUTTING PLI

Marshall Elec. Co., "
omy."
Klein & Sons, Mathias

TOWERS (STEEL)

Benicia Iron Works.
Kierulff, B. F. Jr. &
"Tripartite."
Pierson, Roeding & Co

TRANSFORMERS

American Transformer
"American."
Duncan Elec. Mfg. Co.
Elec. Appliance Co., "
ard."
Ft. Wayne Elec Wks, "W
General Electric Co.
Std. Elec. Wks., "Mold
Wagner Electric Mfg.
"Wagner."
Western Elec. Co., "A
can."
Westghse Elec. & Mfg
"Westinghouse."

TURBINES

STEAM TURBINE

General Elec. Co., "Cu
Western Elec. Co., "Ra
Westghse Machine Com
"Westinghouse-Parso

WATER TURBIN

Pelton Water Wheel
"Pelton-Francis."

TELEGRAPH INSTRUM

Western Elec. Co.

WIRE

ALUMINUM WIR

Pierson, Roeding & Co.

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THE EFFECT OF SNOW-LOAD ON TELEPHONE AND TELEGRAPH LINES

By M. Kawara.

An interesting paper on snow load on telephone and telegraph lines was presented at the recent meeting of the Electric Science Association at Tokio by Mr. S. Kanda. He has been a government engineer for twenty-five years. Below is an abstract of his paper.

Damages done by snow are quite frequent and severe, particularly in 1908. On February 9th the lines in Aflanta, Ga., and its vicinity were damaged to a considerable extent, causing great confusion and inconvenience. On February 29th, around Somerset, England, large damages were done by snow; again on March 3d, in Wiltshire, England, snow caused wreckage of many poles and lines. In this latter instance, some iron poles were badly bent and many were brought down flat to the ground. How extensive the damages were can be realized when we learn that the repair work took ten days and nights. In Michigan, Ohio and Iowa many lines suffered similarly from snow in March. The severe snowstorm of April 9th around Tokio did more damage than any other so far as known in Japan. These occurrences warrant careful study of effects of snow load on telephone and telegraph lines.

The Tokio snowstorm was confined within the radius of about twenty miles; and yet in this small area the damaged poles numbered over 1000, and cross arms 1300. Of 17,000 telephone subscribers in Tokio, only 5800 remained intact, the rest being put out of commission temporarily, and the broken telephone lines alone numbered 280,000. A careful study on damaged poles showed the fact that most poles break either near the ground or at the lowest groove cut for cross arm. Tipping of poles was numerous; and this seems to be the first step toward breaking, for as will be shown later poles have very little resistance against horizontal stresses, and as soon as the vertical stress acts off the axis of the pole, the force tending to bend or tip increases enormously, the final result being the complete wreckage. Many copper telephone lines were not able to sustain the weight of accumulating snow and in some places iron telegraph wires, weighing 400 pounds to the mile, broke simply of snow load.

Telephone Pole in Sierra Nevada Mountains which was 8 feet Under Snow Before Shovelling was started.

In this connection experience with hailstones may be of interest. Heavy hailstones fell around Tokio in last June. Again, many telephone and telegraph lines were broken from impact of heavy hailstones. Some hailstone specimens picked at random measured from two to three inches in diameter. The largest one is reported to have weighed a little over five pounds. Such hailstorms are, however, of very rare occurrence, and no provision can be made to guard against them on economical reasons.

The specific gravity of snow is variously stated by different authorities. The report from a Japanese observatory says that snow in the months of January and February has a specific gravity of 0.05, in November and March 0.06, and in April 0.14. The snow in the recent snowstorm around Tokio weighed 16.2 pounds per cubic foot, or had a specific gravity of 0.26. This was apparently due to the large amount of water it contained.

The quantity of snow that can stick and stay on the line is chiefly determined by circumstances. In the recent storm above referred to, it clung to the line approximately circular in form and its diameter measured 3¾ inches. (Mr. Abbot states in his Telephony that average snow coating is from ⅛ to ¼ inch.) In exceptional cases, it is reported that six, eight, and even a foot of frozen snow on lines were observed. Therefore, it appears necessary to provide for about 6 inch snow load on each line. If we assume a density of 30 pounds per cubic foot, which seems to be reasonable, the weight of snow per foot of line becomes about 6 pounds, or 900 pounds for 150 feet span. This will produce about 15,000 pounds on each pole with 20 lines. From Euler's formula it can be shown that this vertical load calls for 9 inch diameter pole if the height is 18 feet. The following, Table I, shows the maximum allowable vertical load:

TABLE I.

l	D	V
18	9	11,681
20	10	18,129
22	11	21,931
24	12	26,100
28	14	35,522
30	16	40,781

TABLE II.

a	n
100	52
120	43
150	35
180	29
210	25
240	21
270	19
300	17

l = height above ground in feet.

D = diameter of pole in inches.

V = allowable vertical load in pounds.

If l be assumed to be 24 feet, D 12 inches, the number of iron wires, weighing 400 pounds to the mile, that can be strung on safely against a snow load of 5½ inches diameter is shown in Table II, in which n is the number of wires and a the pole span in feet.

It is known that the resistance of a pole against a horizontal force is

$$H = \frac{\pi R^3 T}{K l},$$

in which R = radius of pole, T = resistance to rupture per unit of pole material, l = height above ground, and K = constant depending upon the pole material and the units of measure used. Mr. Kanda gives values of H for cedar poles commonly used, as in Table III. If we take again the case of 24 feet 12 inch pole, the allowable horizontal stress is 3240 pounds. This is only

TABLE III

l/D	9	10	11	12	13	14	15	16	17
20	1640	2250	2995	3888	4918	6174	7594	9216	11154
22	1493	2048	2726	3585	4498	5613	6904	8376	10040
24	1368	1877	2498	3240	4123	5141	6328	7680	9212
26	1269	1722	2292	2991	3806	4672	5841	7089	8503
28	1171	1607	2139	2777	3534	4410	5427	6583	7896
30	1092	1499	1995	2592	3299	4116	5062	6144	7369

one-eighth of the corresponding vertical stress. Hence it appears to be safer to determine the diameter of poles with reference to probable horizontal stresses. This is, however, hard to estimate. For even if we assume that all vertical loads act through the axis of the pole (which is not generally the case), breaking of wires, or snow load being blown off on one side of the pole, will cause considerable horizontal stress. Again, when strong wind blows laterally at the time the lines are loaded with frozen snow, the wind pressure acting on the pole will be enormous. Such being the case, perfectly safe pole lines against all possible dangers are impossible to build on economical reasons. However, observance of the following simple rules will minimize annoyance and trouble to some extent. First, adopt as short and [illegible] span as possible; second, lines ought to be as near level as practicable; third, soft, swampy places are to be avoided; [illegible] guy wires are useful and ought to be placed at frequent [illegible]; fifth, make grooves for cross arms as shallow as permissible; sixth, make radii of curvature at curves large; poles ought to be straight.

PRELIMINARY REPORT ON TELEPHONES.

Continental United States

(Exclusive of Alaska, Hawaii, Philippine Islands and Porto Rico)

The statistics relate to the years ending December 31, 1907, and 1902. The totals include reports of all commercial and mutual systems and farmer or rural lines, but do not include reports of telephone lines operated by steam and electric railways; nor do they include reports of isolated systems operated exclusively for the benefit of commercial and manufacturing enterprises, federal, state, and municipal governments.

	1907.	1902.	Per cent of increase.
Number of systems and lines (1)	22,971	9,136	151.4
Miles of single wire	12,999,369	4,900,451	165.3
Number of stations or telephones, total	6,118,578	2,371,044	158.1
Bell (American T. & T. Company)	(2) 3,132,063	1,317,178	137.8
Independent (non-Bell)	2,986,515	1,053,866	183.4
Number of public exchanges	15,527	10,361	49.9
Number of switchboards (total)	16,065	10,896	47.4
Common battery service	2,146	837	156.4
Magneto system	13,801	10,005	37.9
Automatic	118	54	118.5
Estimated messages or talks during year, total	11,372,605,063	5,070,554,553	124.3
Local exchange messages	11,119,867,172	4,949,849,709	124.7
Long distance and toll messages	252,737,891	120,704,844	109.4
Total income (3)	$184,461,747	$86,825,536	112.5
Total expenses (including taxes, interest and fixed charges)	$140,802,305	$65,164,771	116.1
Total cost of construction and equipment, including real estate and telephone	$819,667,008	$389,278,232	110.6
Capitalization:			
Capital stock authorized par value	$1,121,931,023	$384,534,066	191.8
Capital stock outstanding, par value	$512,685,265	$274,049,697	87.1
Dividends on stock	$23,733,670	$14,982,719	58.4
Bonds authorized, par value	$556,537,932	$158,099,094	252.0
Bonds outstanding, par value	$301,930,739	$73,981,361	308.1
Interest on bonds	$12,316,109	$3,511,948	250.7
Total par value stock and bonds outstanding	$814,616,004	$348,031,058	134.1
Employees and wages:			
Salaried employees, number	25,298	14,124	79.1
Salaries	$19,298,423	$9,885,886	95.2
Wage-earners, average number	118,871	64,628	83.9
Wages	$48,980,704	$26,369,735	85.7

1. The statistics of farmer or rural lines included in this report are confined to number of lines, miles of wire and number of telephones. 1907—17,762 lines, 486,234 miles of wire, 565,649 telephones. 1902—4,985 lines, 49,965 miles of wire, 55,747 telephones. It is probable that a more thorough canvass was made of these lines in 1907 than in 1902, which accounts in part for the large increase.

2. Exclusive of 85,987 farmer or rural stations receiving exchange service through switchboards of "Bell" Companies. A large proportion of these stations were reported as and included in total stations for independent (non-Bell) systems.

3. Includes assessments of mutual systems.

[1]Report of Bureau of the Census.

The final report for 1907 will contain an analysis of the above totals and present detail statistics for other phases of the industry.

In the parks of Chicago it has been found difficult for the cleaning force to keep the boulevards properly swept owing to the great amount of automobile traffic during the daylight hours, and the principal work is now being done at night. In order to prevent the running down of the members of the cleaning force in the darkness, each worker is equipped with a small incandescent lamp placed upon the top of his helmet which is supplied with current from a portable battery carried in his pocket. When the New York City street cleaning force adopted a white uniform for regular wear they were promptly classified as the "White Wings." The public have a happy way of selecting appropriate designations in such cases and they just as promptly dubbed the electric lighted street cleaners in the Chicago parks the "Fire Fly Brigade." This name is particularly appropriate, and "Fire Flies" they will probably be until the end of time.

A REPORT ON METHODS OF TELEPHONE ACCOUNTING.

D. C. & W. B. Jackson, and Arthur Young & Company, the consulting accountants for Chicago, have filed a report on proposed methods of accounting for the telephone system. The proposed new telephone ordinance reserves to the City Council comprehensive powers in the adjustment, changing and regulation of telephone rates after 30 months from the company's acceptance of the ordinance, which was December 1, 1907, and thereafter at intervals of five years. For the purpose of an intelligent exercise of the right to regulate rates at the end of 30 months it is considered important that the information produced for the city shall particularly exhibit: (1) the investment required for furnishing each class of telephone service; (2) the cost of furnishing each class of service rendered, and (3) the revenue derived from each class for service rendered. The ordinance clothes the city comptroller with authority to prescribe the form and manner of keeping accounts and records by the company, and the report is in conformity with this authority. The object of the report is to formulate a system of keeping records and accounts to be adopted by the telephone company so that all the facts, data and information necessary to make proper and reasonable regulation of rates may be furnished to the city.

A more comprehensive system of record keeping and accounting than has heretofore been introduced by any telephone company is required to make apportionment of costs among the many different classes of service established by the ordinance, and this report is in a sense without the guide of precedent. To accomplish the purpose, the costs of giving service must be separated and properly apportioned among the different classes of service. The rate schedule of the ordinance requires the company to maintain a comprehensive service suited to all classes of users, which analyses into 15 different classes of service for "Chicago Exchange" users, seven classes of service for "Neighborhood Exchange" users, and two special classes embracing private lines and mileage extension lines. These are enumerated in detail in the report. They are all for service within the city. Toll service to points outside of the city is additional thereto.

The city probably will eventually desire to have a complete inventory and appraisal of the physical property of the telephone company. However, the plan of accounting laid out in the report expects that suitable subdivisions of the plant may be reached through accepting the divisions found in the telephone company's accounts, and deriving the further subdivisions by mathematical processes and engineering estimates. This will serve all the needs of the present, and a complete inventory can be ordered when the city finds that it would be desirable.

The investment and operating cost for telephone service may be divided into two principal parts: (1) a part which may be assumed to be independent of the amount of use of the telephones and is fixed for any class of service in substantial accordance with the apparatus required to give the type of service for that class, and (2) the remaining part dependent almost directly on the amount of use of the telephones; that is, on the extent of the telephone traffic. Illustrative examples indicating the necessity of this subdivision are given in the report. The phrase "Readiness to Serve" is adopted in the report to indicate the first part, and the phrase "Service Rendered" to indicate the second part. The setting apart of these two parts of plant from each other is difficult because of the lack of adequate means for keeping separate records of messages belonging to each class of service. The company maintains a count of the messages from all of those subscribers whose bills are based on messages, and it therefore keeps data from which a record may be made of the messages originated by each coin-box class of service and by each of the regular measured-rate classes (omitting the commuted rate lines). It also makes a monthly count (called a "peg count") of all calls for one day in the month, but this gives no information as to the relative number of messages originated by the various flat-rate classes of service of the commuted lines.

The importance of obtaining a true record of the messages originated in each of the latter classes of service will be understood when it is known that much the greater part of the traffic handled by the company's central office comes from the flat-rate and commuted-rate lines. The results of a recent peg count taken at central offices serving the business part of the city show that 17,011 lines in these classes originated no less than 632,796 calls during 24 hours, while the 36,668 measured-rate lines of the same central offices originated only 400,356 calls during the same 24 hours. Similar results are exhibited by the records of all the monthly peg counts.

As already indicated, a large part of the cost of giving service is proportional to the amount of the traffic, and it is an essential feature of the plan presented in the report that the records of traffic shall be complete. The great disparity in the traffic of the different classes must make a large difference in the cost of service, and the conditions relating to the cost in the different classes cannot be adequately known until arrangements have been devised for keeping classified records of the messages originated by the flat-rate and commuted-rate subscribers, as well as the others. The most satisfactory way of doing this is by putting a message register or meter on every flat-rate and commuted-rate line; but, owing to the fact that message registers are not yet installed, the company should organize a special force of clerks for counting and supervising the counting of these messages until registers are installed. The report points out that the company is now taking steps to organize such a force.

It is obvious that over 170,000 telephones cannot be considered individually, one by one, on account of the insuperable difficulty and cost of keeping records, but that they must be considered in groups of similar character. These groups are fixed by the schedule of rates imposed on the company by the ordinance. The service to meet each subscriber's needs most economically can be obtained by him from some one of the classes of service of the rate schedule, and subscribers of reasonably similar requirements are therefore attracted together in groups corresponding to the rate classes. The rates are so numerous and carefully adjusted that every user can get telephone service adapted to his needs. It is therefore convenient and proper to adapt the accounting methods so as to arrive at the average cost of service for each of these classes. In pursuance of this object the report shows a plan for apportioning the company's investment among the same classes, and segregating the revenue according to the classes.

No inter-works telephone system is used by the Hening-Hall-Marvin Safe Co. of Hamilton, Ohio. C. M. Carpenter, president of the company, argues "That a foreman will not work so far on his own responsibility with a telephone at his elbow as he will if he must walk to the general office when he wishes to speak with his superintendent. We believe that a telephone system in a factory will waste as much time by making possible useless intercourse, as it will save by giving added facility. It is the facility that causes the waste. When it is hard to spend money, it is much easier to save it—and so it is with time. Again, without the telephone we throw the superintendent into more intimate and personal relation with his men. By going into various departments, instead of talking into them, his presence has a good effect on the activities of the works. When he goes to see the condition of work and progress obtained, it is not possible for foremen to give excuses that might be accepted over the telephone."

A license tax for telephone companies is required in Oregon. The Pacific States T. & T. Co. has lost in both the Circuit and Supreme Courts in Oregon in questioning the constitutionality of the initiative and referendum amendment adopted by the people in 1906. The company is required to pay the annual license tax of 2% upon its gross receipts and to make annual statements to the State Treasurer. This decision will probably be appealed to the Supreme Court of the United States.

LOCAL TRAFFIC.[1]

By A. J. Shands

The subject of local traffic is quite large, and to deal with it properly one would have to start from the very beginning and go through it step by step. Just where the beginning would be is a matter of opinion. Some would say the beginning is with the switchboard specifications, and that is not too early to begin, but as that seems to be more engineering than operation, we will begin with the new applicant.

The selection from applicants of persons to become student operators is not as easy a problem as might be expected. In selecting from the many applicants a few to become operators, a great deal must be considered. A thing that should not be lost sight of for an instant is that the selection is one that is going to affect the company in the future. Will the applicant be an operator up to the required standard? Do her general actions indicate that she will be quick and active enough to handle the number of calls expected of all operators in time? Does her tone of voice, her accent, impress you in a way that makes you think that she is a person that is fitted for the place of representing the company in handling its greatest asset, the best advertisement that a telephone company has, and do this in a way so that the public (the ones that are to be pleased) will say your service is good service?

It is a grave mistake to admit an applicant just because she is recommended by some one who is connected with the company, or for a similar reason, if she does not come up to the necessary requirement. These cases not only cost the company money by trying them or giving them a chance, but take up a great deal of time that is also a dead loss. Operators from this class will almost invariably do more to break down good service than they will to maintain or improve it.

All these things having been considered, together with her height, sight, etc., and the applicant having been employed, then come the first instructions. The student is taught the meaning of the words jacks, cords, keys, etc., is taught to select numbers in the multiple, and the various symbols and markings, and it is not so very long before she recognizes these in a mechanical sort of way. But this is not true with the words or phrases she is taught to use. It is not hard for her to learn the wording of the phrases to be used when the different conditions arise, but to use these phrases with the proper accent and in the proper tone of voice seems to be more difficult. At this point the student should be so thoroughly drilled that she will not only use the phrase correctly worded, but with an accent that carries courtesy in every word. Operators generally do not seem to realize that they control the temperament of the telephone users to a great extent. At least they do not always take advantage of this, as is shown by curt or expressionless replies that are made. A little courtesy costs nothing, and goes a long way toward making our work more pleasant.

After the student has been taught the different markings, phrases, etc., and knows how to operate from the practice she has had, she is passed to the board and her work should be supervised by a supervisor or an older operator. But care should be taken in selecting the operator in whose care she is to be placed. Many employees are very good operators, but very poor when it comes to telling others how to operate. A promising student can be very not the necessary patience and the knack of correcting or coaching her in a way that will show her her mistakes, easily discouraged if she is placed with some one who has but will not offend her or injure her feelings. Student operators are frequently very sensitive until they have acquired confidence. An experienced operator who does not take kindly to coaching students is quite likely to pass a student along as competent too soon, just to relieve herself of work that is irksome to her, and cases of this kind affect the service more than is generally realized. Start the student right and it is not much trouble to keep her right, but let her get away from the instructions or from her own ideas concretely early in her career as an operator, and there is but one of two alternatives—start her all over again, or worry along until she finally ceases to be an operator for one reason or another.

Having coached the student to the point of self-confidence, through the medium of the instructor and the senior operator or supervisor, the next step of placing her in a position to depend upon herself, or nearly so, is equally as delicate as moving her from the instructor's board to the board proper. In most exchanges, especially the larger ones, the load is distributed as equally as possible in all positions; therefore it is necessary that the student take up a position the same as would a more experienced operator, and in placing her the supervisor should be careful to know the disposition of the operators on either side. Should the student be placed between two who will not help her by answering some of her calls, and showing her how to help herself, she is liable to feel the task too great; but if the conditions be the opposite, she will begin to acquire more confidence and speed from the start. Too much thought cannot be given to the first instructions to operators and the subsequent development up to the time they are expected to be competent or capable of caring for the work according to their length of service. A good start is a thing half done.

From this time on the operators are in charge of the chief operators or supervisors and are expected to improve, not alone in accuracy and speed as their length of service increases, but in following instructions that were given before, and the importance of which the student operators do not appreciate. Good service does not only mean quick attention from the operators and connections between the different stations, but means all of this together with the avoidance of unnecessary interruptions. Interruptions are caused by the operators, and their occurrence can be minimized by carefulness on the part of the operators. It is the interruptions caused by cord, key, line, or other troubles which are annoying to subscribers, and which operators frequently notice but do not fully realize what these troubles, even those that appear the most trivial, mean to themselves in their work and to the service. A case of trouble noticed by an operator should be reported by her and reported again every time she notices it, if it is not repaired within a reasonable time after her first report. In large exchanges, about one per cent of the calls cannot be completed, and basing the foregoing statement on this item alone, it will be generally admitted by managers of large exchanges that their "Can't Raise" reports do not equal one per cent of the originating calls. The necessity of team work should be thoroughly explained to the operators. In order to have a uniform answering time, the operators must help each other as much as possible, and the reason for this should be made clear. It is not good practice to tell an operator that she must help the operators on either side of her in just those words, but make it clear that the object is uniformity of answering service, and to gain this one should help the other as much as possible, and by doing this they are helping themselves.

Office discipline and the conduct of the operators, both in the operating room and recreation room, are subjects of importance, and are usually governed by the local conditions with the exception of operators' privileges at the board, and this is a point that modern apparatus has taken care of in itself to a large extent, particularly in the larger exchanges. Operators cannot be permitted to talk to each other while on duty, unless the work demands it, and that

[1] Paper presented at the convention of the International Independent Telephone Association, December 1, 1908.

is seldom. The work in larger exchanges is usually so arranged that there is very little time for personal conversation.

Chief operators and supervisors are placed in charge of the operators, and their duties in part are to see that the operators handle the subscribers' calls according to the instructions given them, to maintain efficient discipline, etc.; but their work does not stop there. They are held responsible for the service given by the operator, and to do this it is necessary that their knowledge of handling traffic must be used. A supervisor cannot give good service if the work of her operators is not good, neither can she give good service if the positions in her division are overloaded during the busiest hours or at frequent intervals during the day. These conditions are not always shown on peg count day, and it is to the supervisor or chief operator that the manager looks for information of these irregular conditions.

In selecting chief operators and supervisors, many things must be considered. A good operator does not always make a good supervisor. It is well, as far as possible, to advance the operators according to their length of service, but this can only be one of the things to consider and by no means should it be allowed to offset any of the other qualities that are so important and which some younger operators may have.

The supervisor should be a good operator—not necessarily one of the quickest—careful in her work, one who has judgment in dealing with the irregular conditions as they arise, and a person who can handle other operators in a way that will cause them to do their best work when she is not watching them as well as when she is. A supervisor who has not the ability, either natural or cultivated, to coach, correct, or reprimand her operators in a way that is not humiliating to or is inwardly resented by them has a difficult time in giving a good service.

In branch exchange systems where "B" or trunk operators are necessary, the selection of these operators is made from the local board of operators, but the requirements are not the same. To select the best "A" operator for "B" work seems the logical thing to do, but this does not always work out as expected. On the "A" board an operator may do good work, but there she controls the number of persons who can talk to her at one time, but on the "B" position it is quite different. And although one is a good "A" operator, she may not be much of a success on the "B" board, simply because she is easily excited or confused. The "B" operator must necessarily be quick to think and quick to act. There are times when the loss of self-control on her part would materially affect the service of some branch office for several minutes. The "B" operator should feel that she is a part of the office whose wire she is handling, and if in full sympathy with them, she will be able to do much to help that office give a good service to the subscribers of that district.

The words "Peg Counts" do not have much meaning to the operators, and sometimes not to the chief operators, and it is usually for the reason that they do not understand why they are taken. From the regular peg counts that are taken a chart is made, and while this shows the changes, gain or loss, from some previous count, and is interesting and useful, the greatest value can be had from the sheets that show the counts as taken by hours, or half hours, as they may be, and the numbers of hours and minutes that the operators worked—the detail sheets. From these sheets the office manager can learn the conditions of each position, not as an average, but as they are at any hour. From these sheets it is frequently suggested that further counts be made for certain hours, or, on some positions, at irregular hours. The distribution of the work over the board and the number of operators necessary are shown.

FOREST SERVICE TELEPHONE LINES IN OREGON AND WASHINGTON.

By W. E. Herring.[1]

Forest Service lines are only constructed in those parts of the country where the field is not covered by commercial companies, and where the business which would be obtained will not justify the construction of a commercial line.

The Forest Service has a general contract with all the large telephone companies by means of which they are enabled to connect with their exchanges or switchboards, and the Government line is treated to a certain extent as a commercial line.

The headquarters of many of the Forest officers are in isolated parts of the country, and in some cases it takes three weeks for an answer to be received to a letter sent by the Supervisor to the Forest officer, although the distance may not exceed 60 or 70 miles. In case of fire it is imperative that help be secured to aid in fighting it. It was in order to remedy this situation and to facilitate the administration of the Forest that the construction of telephone lines was begun. The line most commonly used is a grounded line of No. 12 BB galvanized iron wire. In some cases swinging insulators are used, attached to trees, but in a majority of the cases where not in a heavily timbered country, a pole line is constructed.

The necessity for telephone lines is thoroughly realized, and the help which they have been in different parts of the country during the past year have fully warranted their construction. In one case alone by means of a portable test set, which are used extensively, a Ranger was enabled to summon help from a point 43 miles away, and by doing so a fire which would have proved very disastrous was checked and finally controlled.

Following is a list of telephone lines constructed by the Forest Service in Oregon and Washington:

Oregon.

Cascade National Forest: From Lowell to J. W. Hill ranch, via Hazeldell, 20½ miles, metallic circuit.

Crater National Forest: From Ashland to Ashland Butte Ranger Station, 15 miles along Ashland Creek, grounded circuit. In addition there is about 15 miles of other line on this Forest.

Deschutes National Forest: From Sugar Creek Ranger Station to a connection with a private line near Howard, Oregon, 27 miles, grounded circuit.

Oregon National Forest: From Portland, Oregon, connecting with the city of Portland Water Works' line, seven miles, metallic circuit. From Dufur to Wards' mill, thence to a Ranger Station, 15 miles, grounded circuit. From Sisters, Oregon, to Allingham, 18 miles, grounded circuit.

Umpqua National Forest: From Roseburg eastward via Peel to Black Rock Ranger Station, 70 miles, metallic circuit.

Wallowa National Forest: From Wallowa to Sled Springs, thence to Chico, thence to a Ranger Station, 53 miles, grounded circuit. A short line from Halfway to Cornucopia, nine miles, grounded circuit.

Whitman National Forest: From Sumpter to Cableville and Starkey, with branches, 35 miles, grounded circuit.

Washington.

Chelan National Forest: From Chelan to Stehekin, along the southwest shore of Lake Chelan, 52 miles, grounded circuit.

Colville National Forest: From Republic to Wauconda, with branches, 50 miles, metallic circuit.

All of these lines connect with commercial lines either at exchanges of the Commercial Company, or direct with their line.

A line is under construction from Portland to Gresham, Sandy, and thence over the Divide into the Oregon National Forest, with several branches which will have a total length of 122 miles, copper metallic circuit.

A number of other lines are contemplated on the different Forests in these two States which will be taken up during the spring and summer.

During the fiscal year ending June 30, 1908, over 2500 miles

[1] District Engineer Forestry Department.

of telephone line was constructed on the National Forests, and since that time the construction of 1387 miles of additional telephone line has been authorized. The majority of this has been completed and is in operation, the balance will be completed before June 30, 1909.

This briefly covers the telephone situation in detail in Washington and Oregon, and in a general way in the balance of the western part of the country.

MEETING OF INDEPENDENT TELEPHONE MEN IN BOSTON.

At a conference held at the Hotel Bellevue, Boston, on January 23rd, independent telephone men were present representing an invested capital of about $400,000,000.00. The conference was presided over by Mr. B. G. Hubbell of Buffalo, President of the Conference Committee.

The organization of a comprehensive system for handling long distance traffic was one of the first questions taken up, and in order to facilitate this work it was planned to organize a company to issue interchangeable long distance coupons which will be accepted by all independent companies of the country.

A company was incorporated in Ohio, with C. Y. McVey of the Cuyahoga and United States Company of Cleveland as President, which will take charge of clearing the business. It will be known as the International Independent Telephone Accounting Company, issuing coupon books on the plan of railroad mileage, recognized by companies in Pennsylvania, Michigan, New York, Kansas, West Virginia, Minnesota and Ohio. The companies operating under this arrangement represent about 360,000 miles of wire.

It was the sense of the conference that the present time is favorable for the telephone industry, and that there is ample room for both organizations in the field. While there can be no affiliation between the two, the separate organizations can without industrial warfare find plenty of business to take care of.

The conference went on record as believing in competition, as by competition alone can satisfactory service be made possible. It was the consensus of opinion that there is a greater demand for telephone service than both organizations can now supply and that the plan to be followed by the independents will be that of offering good service at fair rates and allowing the competition to take care of itself.

In the evening a banquet was held at the Parker House, presided over by Mr. A. G. Bean, president of the Metropolitan Home of Boston. The majority of the speakers voiced the need of independent telephone service in the East, especially in Boston, and referred to the success of competition in the West. The principal point commented upon by the speakers was the immense field yet undeveloped in telephone construction, and attention was called to the fact that there is practically no telephone company in the country today that has not a waiting list of applicants for service.

Among those present at the conference, representing the larger companies, were: B. G. Hubbell, Buffalo, chairman; E. L. Barber, Wauseon, O.; A. E. Barker, Detroit, Mich.; F. L. Beam, Mt. Vernon, O.; J. S. Bradley Jr., Toledo, O.; C. C. Cockerill, Jefferson, Ia.; H. D. Critchfield, Chicago; A. C. Davis, Parkersburg, W. Va.; E. B. Fisher, Grand Rapids, Mich.; G. R. Fuller, Rochester, N. Y.; I. H. Griswold, Albany, N. Y.; W. C. Hanlan, Wheeling, W. Va.; J. B. Hoge, Cleveland, O.; [illegible] D. Houck, Harrisburg, Pa.; W. R. McCanne, Rochester, N. Y.; W. J. M[illegible]lchers, Alma, Mich.; M. Koehler, St. Louis, Mo.; G. R. John[illegible]town, Columbus, O.; C. Y. McVey, Cleveland, O.; E. H. [illegible], Minneapolis, Minn.; L. G. Parker, Louisville, Ky.; H. [illegible] Reber, St. Louis; J. C. Reber, Dayton, O.; O. C. Snyder, [illegible] City, Mo.; J. G. Splane, Pittsburg, Pa.; H. C. Stifel, [illegible]; C. F. [illegible], Grand Rapids, Mich.; Charles West, [illegible] P. [illegible] Wilson, Philadelphia; F. H. Woods, [illegible]. The conference was arranged by Bernard M. Wolf [illegible] J. S. Hayes, of the Metropolitan Home Telephone Com[illegible]. The next meeting will be held in Rochester, N. Y.

INSTRUCTION IN TELEPHONE ENGINEERING.

The first instruction in telephone engineering was given in 1877 by Professor Alexander G. Bell and associates, according to G. S. Macomber in the *Sibley Journal of Engineering*. General lectures were given in many large cities in order to rapidly educate the public in the use of the telephone. Detailed instructions of an elementary engineering nature were given to those agents and assistants who were to direct the installation of the telephone instruments and lines in their corresponding section of the country. Before that time each person obtained knowledge about the telephone by investigating for himself. At this time, in order to assist the newly formed company in the exploitation of their apparatus, data of all kinds pertaining to the installation and use of the telephone were collected and disseminated. For a short time keen competition brought about similar bureaus for the collection and dissemination of telephonic information, but this died out in the course of a few years and the Bell companies became the sole custodians of the knowledge of practical construction and operation of the telephone. During the period from 1877 to 1893 modern telephone engineering began, and when the fundamental patents expired in 1893 there was a great rush into the telephone manufacturing and operating fields. This created a demand for men who knew about practical telephone work, both from the so called "Independent" and the "Bell" companies, the latter needing new men to take the places left vacant by older men who had joined the independent ranks. Betwen 1893 and 1898 many telephone, operating and manufacturing companies went through the process of re-organization in which an engineering department was formed. As a result, the duties of the telephone engineer increased considerably. Since the number of men who had a practical knowledge of the subject was very limted, the field offered a fine opportunity for technical graduates, and many of them took up this work. The number of men to take up this branch of engineering work increased so rapidly that the professors concerned began to consider the advisability of special instruction in telephony.

A year ago an inquiry was made among some Cornell graduates now in the telephone field in regard to their ideas of the proper kind of instruction in telephony for engineering students. Among other suggestions an invitation was received, through the influence of Mr. N. M. MacLeod, '07, from Mr. F. A. La Roche, Division Plant Superintendent of the Philadelphia Bell Telephone Company, to visit and inspect their school for the instruction of employees in their maintainance and installation departments. The invitation was acepted and two days pleasurably and profitably spent in the inspection of this interesting school where, through the kindness of Mr. La Roche every facility to make a complete study of the details was offered. The following is an extract from a report giving the results of this study.

By way of introduction it may be said that the Bell Telephone Company of Philadelphia, established their school three years ago as the result of a sympathetic strike of their construction men. As the strike developed suddenly it became necessary to teach new men how to do the work left by the strikers. Young men were secured and given lessons in line construction, cable splicing, etc., and then sent out to make repairs. Within one week from the beginning of the strike the telephone company was able to take care of its work, and after a short time the strike broke up. Before the temporary school thus hastily established was closed it became evident that it would pay to extend the instruction and increase the facilities. This was done; and now after three years' trial it is considered a very profitable investment for the company.

There are at present two schools, one for installers, and one for maintenance men. The work of each is the same in general but differs in its details. The men who enter these schools are from the working force of the company and are under regular pay just as if they were doing the work of their respective departments. In the aggregate they devote six weeks, more or less, to the school work. Many of the men who take this work have never seen a book on algebra or geometry, and

others do not have a knowledge of fractions or proportion. It is therefore necessary to give a drill in elementary mathematics to enable the student to solve the most elementary eletrical problems.

Primarily the object of the school is to make the men more valuable to the company and accordingly the work is so conducted as to produce results as rapidly as possible. Although a part of the instruction given would be of value to the students in understanding other branches of telephone work, essentially it is directed toward maintenance and installation. The instruction is not intended to cover the telephone field broadly, but goes into every detail that is necessary to enable the men to locate the cause of, and to repair, with maximum speed and a minimum injury to the apparatus, troubles which develop in the particular types of apparatus used.

The physical equipment which is used by this company is limited strictly to apparatus of certain types that is manufactured by the Western Electric Company. There is no magnetic telephone apparatus in the school, this type not being used in the Philadelphia District. The maintenance school equipment consists of a standard type power switchboard, duplicate ringing machines, duplicate pole changers, storage batteries, mercury arc charging set, main and intermediate distributing frames, relay rack, fuse panel, resistance frame, one three position section of a No. 1 Western Electric Telephone switchboard, there being one "A" position, one "B" position, and one "Trouble" position, each with corresponding shelf equipment. The face equipment of this board is about 500 multiple jacks arranged specially for instruction purposes; one standard No. 9 board having three positions each equipped with ten cord circuits; one "P. B. X." (Private Branch Exchange) switchboard with a capacity of 25 lines; one Wire Chief's "Desk," equipped with three plugging up lines with visual signals, three cord circuits, one test circuit, two order circuits, two incoming trunks, and two outgoing trunks. In addition to this regularly formed equipment there are about twenty sets of apparatus wired to special terminals and mounted on box frames for detailed circuit study. Besides the above apparatus in the maintenance school there is a somewhat similar equipment for the installers school, and also many small ingenious pieces of apparatus too numerous to mention here in detail. The equipment in these schools has been built up gradually at an aggregate cost of approximately five thousand dollars.

The result of a study of the above conditions may be summarized as follows: With a very complete equipment, first class instructors, and the equivalent of 100 laboratory periods of three hours each, the result produced in the above schools is a highly specialized training giving the student a microscopic view of a very small part of the modern telephone system. For the Plant Department of the telephone company this result is very satisfactory, but for a University course it would be very decidedly out of place. University students with the same physical equipment and amount of time would get much more out of the work. However, after considering the way the work should be modified to meet the needs of a University course it becomes evident that any system of elaborate telephone experiments, would be a serious waste of time for University students.

The methods of, and the equipment for, telephonic instruction at Drexel Institute were also studied. There the work is taken up from the standpoint of the trade school. It may be described as slightly less highly specialized than the above, yet still not treated broadly. Later study of the methods of telephonic instruction at other schools and some colleges lead to the conclusion that there is a strong tendency in the same direction, namely, toward too much specialization.

During the past few years there has been considerable discussion among college professors and also among practicing engineers as to the education of electrical engineering students. Papers on this subject have been presented and discussed at the meetings of the American Institute of Electrical Engineers, and the Society for the Promotion of Engineering Education. A great variety of opinion was expressed at these meetings, but there is a decided leaning toward the belief that the University course could be less specialized, that it should train the students to look at things broadly and that the kind of knowledge given should be such as would apply to all kinds of engineering. Some engineers think that only a degree of Bachelor of Engineering should be given for undergraduate study. The following quotations are from the discussion of papers presented at the June '07, meeting of the A. I. E. E., they express the growing opinion of practicing engineers regarding engineering education. Mr. L. D. Nordstrum says, "It is my opinion that a man has never finished his education, his entire life is that of a student. His University years are merely his starting or foundation years." Mr. J. J. Carty, who is probably the most noted telephone engineer to-day, speaking in regards to the technical graduates who have entered the telephone field under his direction, says, "As a rule men are well trained technically but are often very defective in respect to that broad and liberal training which should underly the technical education of every profesisonal man."

The above statements were intended to apply to the complete four year electrical engineering course, but it is believed that they can be applied to the short specialized telephone course. The following requirements of a course of instruction for telephone engineers are suggested. The general course for telephone engineers should not be too highly specialized, but of a very broad and general character including among the general engineering subjects such allied subjects as patent law, economics, architecture. The special telephone instruction should be given in a course which—must be short, in order not to take too much time away from the general engineering studies; should not aim to teach that which can easily be learned in the first few weeks or months of practical work; should include statements giving practical advice as to what non-electrical parts of his technical course will probably be found of greatest importance in practical work of the telephone engineer. The keynote of the course should be an accurate resume of the fundamental principles involved in the operation of telephonic apparatus, and in the organization and management of the telephone system as a whole. This should be so thoroughly treated that the student understands fully, then he will not soon forget. To accomplish this a few illustrations from practice should be carefully studied. The subject matter should be so presented as to develop reasoning power and interpretation of engineering data.

With the above facts in view instruction will be given at Sibley College in telephone engineering during the coming term through a small number of senior students. The work will consist mainly of lectures, sometimes illustrated with lantern views, sometimes experimental and with occasional inspections of practical telephone systems. A trip to one of the larger cities may be undertaken to impress the relative proportions of the telephone system. Telephone laboratory work sufficient to give the student a general idea of the method of operating a telephone switch-board and the essential features of a common switchboard circuit has been arranged in the regular electrical laboratory course for all electrical engineers. Therefore this will not be taken up in the special course for telephone engineers. They will devote sometime to a more detailed study of single pieces of apparatus in order to gain a thorough knowledge of principles of operation, limitations, etc. In addition some special engineering research will be offered to those who are prepared to do such work efficiently.

It is hoped and believed that this system of instruction will give students a broader conception of telephone engineering and a more thorough knowledge of the fundamentals.

The remains of the heroic telephone operator, Mrs. S. J. Rook, former telephone operator at Folsom, N. M., have been found deeply buried sixteen miles below Folsom. During the great flood at Folsom last August, Mrs. Rook, who realized the danger, remained at her post, warning the farmers of the valley by telephone until the telephone station was overwhelmed by the waters. Her action saved hundreds of lives.

THE ELECTRIC CLUB OF CALIFORNIA.

The Electric Club of California held the most successful meeting of its existence on February 4th at the Hotel Argonaut, San Francisco, 71 members being present.

The meeting, as usual, took the form of a luncheon, followed by a few informal speeches and an unusually interesting article by E. S. Sherwood on the subject of incandescent lamps.

The large number present and the enthusiasm shown seemed to justify the change made in the meeting day from Saturday to Thursday.

E. M. Scribner, Jovian statesman for California, among other speakers, talked upon the subject of Jovianism and its object, and called attention to the Rejuvenation which will be held on the night of February 13th, urging every member of the Electrical Club not now a member of the Jovian Order to be present.

Next to the luncheon itself, the important feature of the meeting was the very instructive article on tungsten lamps by E. S. Sherwood, lamp expert for the General Electric Company. The article was illustrated by numerous lantern slides, Mr. Sherwood being assisted in the lantern work by C. C. Davis and F. D. Fagan.

H. F. Frosch, President, Electric Club of California.

At the conclusion of the meeting, President H. F. Frosch called attention to the fact that the present officers and directors of the club have been serving temporarily during the period of organization, and suggested the advisability of placing the club on a permanent basis by the election of permanent officers.

In recognition of the past work of the temporary board and the success they have achieved in bringing the club to its present prosperous condition, it was moved by John R. Cole that the temporary officers be made permanent, which was unanimously carried.

The permanent organization as now made up is as follows: President, H. F. Frosch; Vice-President, A. E. Rowe; Secretary, R. D. Holabird; Treasurer, E. D. Poss; House Committee, F. H. Poss; Directors—H. F. Frosch, A. E. Rowe, R. D. Holabird, E. D. Poss, Frederick S. Mills, R. L. Wolden.

Steam turbines were mounted on rubber foundations to obviate any possibility of vibration in a recent installation at St. Pancras borough, England. The 2,000 k. w. steam turbine has been bolted to a reinforced concrete slab which rests on a series of small rubber stools, the stools themselves resting on an ordinary concrete foundation.

THE SONS OF JOVE.

THE Sons of Jove, that band of electrical men with an object most serious and worthy, but with no particular home, will hold its first Rejuvenation of the year on Saturday evening, February 13th, at the Hotel Argonaut, San Francisco, when it is expected that a large number of new members will be initiated.

The ceremony of Rejuvenation will take place at 6 o'clock and will be followed at 8 o'clock by a German supper, which will include everything in the eating and drinking line for which the land of the Kaiser is famous. The supper is in charge of H. F. Frosch, who has had a broad experience in handling affairs of this kind, and his name is a guarantee of its worth—particularly as it is to be a German supper.

MENU.

Caviar on Toast.
Marinette Herring.
Sardelles.
Radishes. *Olives.*
Frankfurters with Sauerkraut.
Kartoffel Salad.
Schweitzer Kase.
Beer.

The preliminary work on organization of the order has been in charge of T. E. Bibbins, first Statesman for California. E. M. Scribner, with the beginning of this year, accepted the appointment of Statesman as his successor, the work of Mr. Bibbins being recognized by his appointment as a member of the Seventh Jovian Congress. This Rejuvenation will therefore be the first one under the direction of the new Statesman.

With the exception of a short address by Mr. Scribner, incoming Statesman, and a response by Mr. Bibbins, retiring Statesman, there will be no speeches. In lieu of speeches the entertainment committee, made up of R. L. Phelps, F. H. Poss, and H. F. Frosch, has prepared a very interesting musical entertainment; this will include a number of popular songs and the famous Jovian Choir will render the Jovian Hymn.

The Jovians have amongst their number sufficient vaudeville talent to supply an evening's entertainment, and under the direction of the above committee, this part of the program will undoubtedly be a success. Mr. Frosch, who uses the Steinway exclusively, will preside at the piano.

The various committees have worked hard to make the affair a memorable one and everyone is expected to have a busy evening except the policeman on the corner.

Zinc white from ore by the electric furnace is being successfully made at the Arudy Works in France. A perfectly white zinc oxide is obtained directly from crude low grade ore by electrically smelting it with lime and carbon. Electric power cost $13 per h. p. year and carbon electrodes $4.60 per pound. A 100 h. p. furnace produces 30 lbs. hourly with a current consumption of 68 kw.-hours from a 46% ore.

Chicago Telephone Company has 180,000 telephones connected, being the second largest telephone exchange in the world. The growth last year amounted to 35,000 instruments, which was equal to the entire growth of the first twenty-three years of the company's existence. The average number of calls per subscriber is twenty-two calls per line per day. There are thirty-five exchange buildings. The underground conduit amounts to 435 miles, there are 377,000 miles of underground wire, and the overhead wire foots up to 65,000 miles. The company employs about 5600 operators.

CURRENT COMMENT

Electric power generated by Niagara Falls is now being distributed at a distance of 125 miles from its source, and the Canadian Government is planning to more than double this distance.

The largest advertising sign in the world, it is claimed, is at Jersey City, N. J. It is 200 x 50 feet with letters 20 feet high and 3,000 incandescent lamps are used in its construction.

The first French automatic telephone system has recently been installed at Lyons. The initial apparatus has a capacity of 200 subscribers, but will be enlarged if the system proves satisfactory.

Automatic gas buoys have been placed in the harbor of Colon and Cristobel to mark the channel of the Panama Canal as it has been dredged from deep water to the shores. They are charged with calcium carbide and remain lighted six months without recharging.

Piles preserved by water, after an interval of sixty years, have been encountered by the dredge working from the old French canal into the prism of the new Panama Canal at the north end of the Gatun lock site. In making a cut through the old line of the Panama Railroad it was found that piles had been completely rotted down to sea level, but below were as sound as when they had first been driven.

Contracts for wireless apparatus were recently closed by the Oceanic Steamship Company with the United Wireless Telegraph Company for the installation of wireless plants on the steamers Mariposa and Alameda. The installation will be made as soon as the liners return to San Francisco. The Alameda will be the first to be fitted for this work, arrangements now being made to equip her upon her arrival during the coming week. Work on the Mariposa will begin in about a month. This system will enable the steamers to keep in touch with both this Coast and Hawaii nearly every day when they are at sea.

Bare aluminum wire may safely be used in coils without any insulation except between successive layers, owing to the existence of a film of oxide on the surface of the aluminum. The film in its natural state, says the Scientific American, will resist 0.5 volt; but by exposing it to the air at a temperature of about 100 degrees C. it is possible to get rid of the hydrates contained in the film, and thus increase its resistance so that it will withstand a high voltage. The insulation between the layers of the coil should be non hydroscopic, and the coils should be covered with insulating paint to prevent moisture from entering.

An arrest by wireless telegraph was accomplished recently by the police department of Oakland, California. J. J. Pember Jr. was arrested on a charge of embezzlement preferred by Sheriff J. W. Farrell of Eureka. Pember had left there several days previous. As the wires of the Western Union were down between San Francisco and Eureka, the Sheriff's message was filed with the Government wireless station there, received at the Mare Island station, and forwarded to Oakland. The arrest was made under the direction of Captain of Detectives Petersen, who informed Sheriff Farrell by wireless that his man was in custody.

Telephonic communication between mounted operators has been accomplished by Lieutenant A. C. Knockles of the United States Army, who has devised an ingenious arrangement whereby the horse is made a part of an electrical circuit. By this device the mounted operator is able to transmit messages to his base whenever necessary without dismounting, and is accomplished by placing a small piece of copper (properly connected to the telegraph or telephone instrument) against the animal's body, thus completing a ground connection through the horse's hoofs. The tests were made over all kinds of ground, and conversation is said to have been carried on between two operators five miles apart.

An interchangeable coupon book has been designed by Mr. J. B. Hoge, of Cleveland, Ohio, the well known independent telephone manager, for the use of the long distance telephone companies of the country, patterned to some extent after the books used by the electric railways which are members of the Central Electric Railway Mileage Bureau. The coupons are for five cents each, and as many may be taken out as are required to pay for a message at the office of any of the companies that enter into the arrangements. A clearing office will be established at Cleveland, and all coupons will be sent there, where settlements with the companies will be made. It is understood that all the independent long distance companies will become members of this bureau. In fact, many of them have been working for some time to secure a uniform plan of some kind along these lines. The books will insure a reduction in the rates, because of the fact that the purchaser pays in advance for many calls. The companies can thus afford to do this.

Telephone politeness in England is defined in a recent circular of the British postoffice. It says: "In order that abrupt and uncouth expressions may be avoided in the telephone service, telephonists engaged at trunk exchanges are in the future to make use of the following expressions in connection with their work, and the supervising offices should impress upon the staff generally the necessity of adhering to the authorized form of words." Entering into details this official guide lays stress upon the advisability of using the word "please" where it can conveniently be introduced. "The telephonist answering a call should announce her presence by saying 'Trunk number, please?' Failing to hear what the subscriber says, she should say: "What is your number, please?" and so on. "When a subscriber's attention has been obtained for the trunk call the telephonist should say: 'What is your number, please?' If the subscriber should be kept waiting for more than the regulation time the telephonist should add: 'Sorry to have kept you waiting.'"

The interchange of long-distance business between the Bell companies and the independents wherever it is necessary to do so in order to get a message through to destination, is the subject of a bill Representative A. B. Canfield has introduced in the Ohio House of Representatives. It provides for forfeiture of the charter of any company that refuses to connect its lines with those of any other company whenever it is necessary to transmit a message in that way. In the past efforts have been made to secure such a law, but not enough members could see the necessity of putting requirements upon the companies that might destroy competition and make it impossible for the further development of territory by the independents. This bill also contains a provision limiting the rate that local exchanges shall charge to $24 a year in cities of 100,000 population or less, with an increase of $6 for each 100,000. For long-distance business the rate is to be not more than half a cent a mile for five minutes' conversation. The difference in the length of conversation is the greatest change over present rates for long distance service.

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CONTENTS

High Telephone Rates in Large Cities

Why is it that I have to pay more for a telephone in a large city than in a small town? Why has the rate for telephone service in this community been doubled during the past ten years? These and many other similiar questions meet the bill collector on every trip. He often does not know why, and must refer the subscriber to the office, and yet if he did but know it, the answer is as simple as it is short—it costs the company more.

The telephone business differs from almost every other in that its cost does not decrease as its quantity increases. There is no wholesale rate in telephone service. The cost of installation and operation becomes greater as the number of subscribers increases, and consequently in a growing town telephone service costs more as time goes on, and in a great city the cost is necessarily many times that of a small suburb.

There are several factors which combine to make this increased cost. Some, such as real estate and high wages are common to all industries in large cities, others are peculiar to the telephone business. A small town has one central office with few operators and simple apparatus and all wires are carried on poles. A large city requires several central offices and more elaborate apparatus so that many subscribers may be quickly connected; much of the wiring is underground, thus increasing the construction cost materially.

This matter of increased cost of service in proportion to the growth of an exchange was shown in the report of the committee which recently investigated the renewal of the franchise of the Chicago Telephone Company in which it is stated:

> "The subdivision of a city into exchange districts, with an exchange in each district, necessitates a complete system of intercommunication between each such district and all of the other districts. The complexity of switchboard wiring and the multiplicity of trunking facilities form very expensive items of plant installation. It also necessitates the handling of a very large percentage of messages twice. In a large city a very small proportion of calls are completed within a single exchange. It is usually conceded that about eighty per cent of such calls are required to pass through a second exchange. It is thus plain to see how both the investment and the operating cost are accordingly increased.
>
> "There are additional causes for the increased cost of service, such as higher wages and shorter hours; destruction of underground cables by the interference of foreign electrical currents; higher rates of taxes and insurance; probable higher rates of compensation, and some additional investment for the benefit of the city, in providing space on poles, and ducts and cables, for the city's use."

So it is seen that it is just for the city user to pay more because it costs more. Furthermore he gets more, for he is able to call thousands whereas the subscriber in a small town can call but hundreds. Until some radical change is made in the present methods of telephonic communication there is but little likelihood that telephone rates can be made smaller. The stockholder is entitled to a fair return on his investment, and as this investment increases the bills of the consumers grow greater.

PERSONALS.

Geo. H. Scoville, resident engineer for the Dean Electric Company, is away from San Francisco on a brief trip to Southern Oregon.

B. C. Van Emon, of the Van Emon Elevator Company, San Francisco, returned this week from an extended trip through the Northwest.

W. A. Purcell has been appointed San Francisco representative of I. P. Frink, 551 Pearl street, New York City, manufacturers of reflectors.

R. L. Phelps, of the San Francisco office of the Safety Insulated Wire and Cable Company, is in the Northwest and will return to San Francisco about February 15th.

Herbert D. Crouch, sales manager of the Northern Electrical Manufacturing Company, Montreal, spent the past week in San Francisco and left for Vancouver on Monday night.

Mr. F. H. Poss, of the San Francisco office of the Holophane Company and the Benjamin Electric Manufacturing Company, returned on February 6th from a six weeks' trip to the Hawaiian Islands.

J. H. MacNichol resigned as manager of the Pacific Telephone and Telegraph Company's office at Colfax, Wash., and has been succeeded by H. W. Schilling, formerly employed in the Spokane office.

J. E. Way, sales manager for the R. Thomas & Sons Company, porcelain manufacturers of East Liverpool and Lisbon, Ohio, has spent some time in Seattle and is due in San Francisco the latter part of this week.

George C. Heckman, formerly with the General Electric Company, in charge of power and equipment at the Fort Wayne Lamp Works, is now manager of the San Luis Gas & Electric Company, San Luis Obispo, Cal.

J. E. Wickstrom, of the Seattle-Tacoma Power Company, Seattle, is at Everett, Wash., as general foreman in charge of the sub-station, operation and construction, and the transmission line from Everett to Snoqualmie Falls.

Louis F. Leurey, formerly with Sanderson and Porter, on the Nine Mile Bridge development in Spokane, Wash., is now engaged in electrical construction work for the Union Construction Company on the Stanislaus electric power development in Calaveras County, Cal.

Mr. W. I. Hess is now in charge of the Dale Company, fixture manufacturers of New York, as manager, succeeding Mr. H. S. Salt, who severed his connection with that company on January 1st to enter business at New York as manufacturers' representative.

E. H. Cleveland, formerly employed by the plant department of the Pacific Telephone and Telegraph Company in Oakland, has been promoted to the position of manager of the company's exchange at Watsonville, succeeding Harry Westbrook, resigned.

A. N. Palmer, of the Phillips Insulated Wire Company, Pawtucket, is in San Francisco. He is making his annual trip to the Coast and reached San Francisco last Monday. He will spend the balance of the week in San Francisco, going from there to Los Angeles.

Mr. J. R. Mitchell, Secretary of the Doerr-Mitchell Electric Company, of Spokane, spent the early part of this week in San Francisco. Mr. Mitchell was one of a party of Spokane commercial men who are making a trip of the Pacific Coast and who were entertained while in San Francisco by the Chamber of Commerce of both San Francisco and Oakland.

A. C. Downing, Pacific Coast sales engineer for the Studebaker Automobile Company, has returned to San Francisco after a five months' trip throughout the Western States.

P. H. Coolidge, manager of the Western Electric Company, San Francisco, has returned from an Eastern trip, during which he participated in the sales conference of his company at Chicago, and later made an Eastern trip which included New York and Boston.

Theodore G. Seixas has been elected vice-president of the Pacific Traction Company, with offices at Tacoma, Wash. Mr. Seixas is to have charge and reorganize the several companies controlled by the eastern interests he represents, including water powers in the State of Washington.

C. H. Johnston, manager of the pole department of the Western Electric Company, on the Pacific Coast, has been in Los Angeles during the past week. In addition to several days in Los Angeles, he spent three days and three nights on the return trip, the delay being due to the washouts.

Harvey Hubbell, of Harvey Hubbell, Inc., and W. C. Bryant, of the Bryant Electric Company, Bridgeport, Conn., accompanied by Mrs. Hubbell and Mrs. Bryant, have planned a Pacific Coast trip, combining business and pleasure, for the latter end of February. Mr. Bryant has made frequent trips to this territory in the past but it will be the initial trip for Mr. Hubbell and a strong effort will be made by his Pacific Coast friends to sustain the well earned reputation of the Pacific Coast for hospitality.

TRADE CATALOGUES.

The Kellogg Switchboard and Supply Co. will send to those interested in construction and line material, etc., their revised price list recently issued, which is complete, covering this entire line. If desired, their bulletin No. 17, description of line material and supplies will be forwarded with the price list.

An attractive little booklet, the front cover illustrating the factory and cut to the shape of the building, containing numerous views and descriptive matter, of some recent switchboard installations, has recently been issued by the Kellogg Switchboard and Supply Co., Chicago. The halftones show interior views of exchanges, front and rear illustrations of switchboards, distributing frames, relay racks, power equipment, etc. These exchanges are of the latest type.

A bulletin, No. 40, describing their new pole changer, has recently been issued by the Kellogg Switchboard and Supply Co., and will be sent on request to those interested. It is well illustrated with different views of the apparatus, and descriptive matter that states what the pole changer will do and its efficiency, in a conservative way that can be depended upon. Anyone contemplating the purchase of such an instrument will be interested in this bulletin, and the company's engineering department will be glad to give any further information needed.

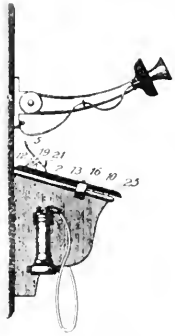
The Harvard Electric Company, 66 W. Van Buren street, Chicago, and 136 Liberty street, New York City, have issued a new catalogue known as No. 17, which is descriptive of a part of the many electrical necessities made by them. This catalogue is the fore-runner of a complete new series of printed matter illustrating Harvard Dependable electrical necessities. The No. 17 catalogue describes Harvard Patent Steel Brackets, Harvard Beveled Edge Self Welding Wire Joints, the Improved Harvard Sectional Switch Boxes, etc., etc. A copy of this catalogue will be mailed to any one interested, upon request.

TRADE NOTES.

The Pacific Electric and Manufacturing Company have moved their offices from 701 Atlas Building to 80 Tehama street, San Francisco, the expansion of their business making larger quarters necessary.

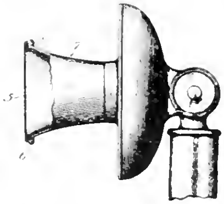
PATENTS

908,490. **Telephone Attachment.** Newell B. Parsons and Albert Beutler, Chicago, Ill., assignors to Belden Manufacturing Company, Chicago, Ill. In an attachment for telephones, a metal base; wings formed from and integral with said base; a pad-retaining clip pivoted on said wings; clamping jaws



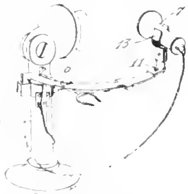
slidably attached to said metal base; and a rib stamped in said metal base, constituting at the same time a pencil groove on the upper surface of said base and a projecting rib parallel with one of the edges of said base on the underside of said base.

910,383. **Sanitary Shield for Telephones.** Owen H. Hudgen, Los Angeles, Cal. A telephone transmitter shield, comprising a circular diaphragm of relatively thin elastic material and of a smaller diameter than the telephone mouthpiece, said diaphragm having formed integrally therewith on



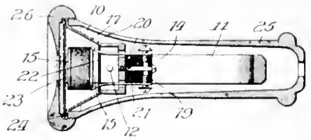
its periphery an annular rib of relatively heavy elastic material, said rib being substantially circular in cross section and projecting equally beyond the plane of each face of the diaphragm, whereby either side may be utilized as an outer face.

910,189 **Telephone Attachment.** Joseph C. Fox, Seattle, Wash. A device of the type set forth comprising a support composed of two sections slidable one on the other, guides on the respective sections of said support, the guides of one



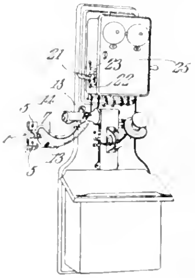
[illegible] embracing the other section, each of said sections [illegible] formed with notches adjacent the guides thereof, and [illegible] on said support for adjustably holding the receiver of a telephone

910,603. **Telephone Receiver.** Alfred Stromberg, Chicago, Ill. In a telephone receiver, a diaphragm with a reinforced



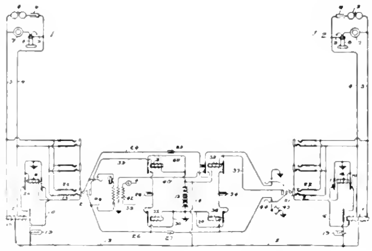
edge, said reinforced edge consisting of a ring of metal spun upon the diaphragm and forming a reinforcing ring upon each side of the diaphragm.

910,918. **Support for Telephone Receivers.** Robert S. Griffith, Berkeley, Cal. In a device of the class described, a U shaped bracket having flat, horizontally disposed arms, the said arms near their terminals oppositely bent into a vertical plane and adapted to receive support engaging means, the outer end of the bracket having a vertically incised slot; oppositely dis-



posed shoulders projecting inward from the edges of the slot; a curved tube loosely mounted in the slot to the rear of the shoulders and normally fulcrumed upon the said shoulders; and means for supporting a telephone receiver, mounted upon the curved tube.

908,926. **Three-Wire Telephone System.** Charles S. Winston, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. In a telephone system, the combination with a telephone line, of a cord circuit for making connection therewith for conversation, a third conductor at the central office isolated from the talking circuit, a cut-off relay



and a supervisory relay in said third conductor, a line relay permanently connected with the line, a source of current, a second supervisory relay connected between said source and the sleeve strand of the cord circuit, and a supervisory signal having its circuit jointly controlled by the contacts of said supervisory relays.

INDUSTRIAL

CO-OPERATION.

One of the principal sources of strength in the old established telephone monopoly is the fact that their close organization enables the various companies to interchange valuable ideas. In line construction, in the design of telephone apparatus, and in the operation of exchanges, each of their managers has the experience of many of the others at his disposal.

As a result of this feature, Bell construction has become somewhat standardized, and their exchanges and lines are more or less uniform throughout the country. While this effects considerable economy, it has offered the Independents an enlarged opportunity for successful competition.

For several years after the Independent movement sprang into existence, the various companies were absolutely unassociated. Each manager operated his system without regard to the experience or opinion of any of his associates. While this became the source of serious trouble in handling toll business, it served the remarkable purpose of developing a good many original and valuable ideas. It is interesting to note in this connection, that the Independent manufacturers had to meet all of the varying requirements of a good many different operators.

It is certainly advisable to retain the advantages of this individuality in the further perfection of Independent telephone designs. However, some means of interchanging operating ideas have long been desired and efforts have been made in this direction through the medium of Independent associations, and various other organizations. However, the latest successful effort is being made by an Independent manufacturer.

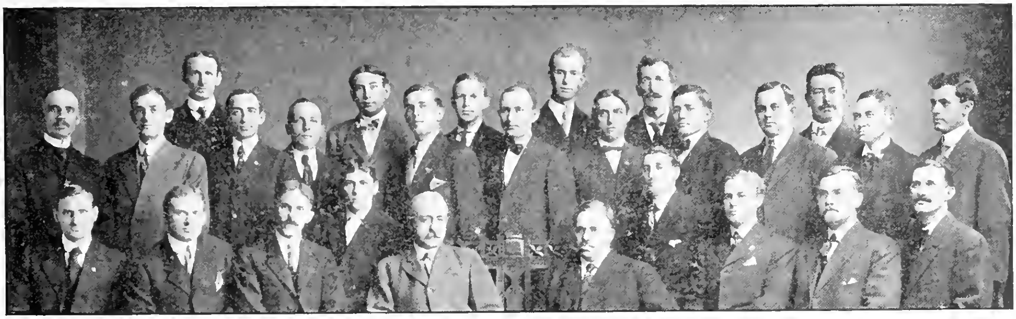
Manufacturers' representatives and engineers are certainly very familiar with the detailed requirements of the operating field. Their business life depends on carefully meeting each operating demand. The Dean Electric Company of Elyria, Ohio, one of the largest Independent manufacturers, has been making an effort to assist the Independent movement in this way.

All Dean salesmen assemble at the factory about the first of each year, for a week of telephone instruction. This schooling includes, primarily, a careful comparison of operating methods throughout the United States and, since representatives are present from nearly every State in the Union, many very interesting features are discussed.

The Pacific organization, which operates under the direction of Resident Engineer George A. Scoville, who is located at the Dean Branch House in San Francisco, was unable to attend this year's meeting. The unusually large business in this territory, and the many pending contracts made it impossible for Mr. Scoville to go East alone for even the few days required.

A few manufacturers follow the plan of occasionally calling in their salesmen, simply for the purpose of discussing selling methods. The Dean idea, however, is unique in that it is based primarily on an effort to assist the Dean customer by so educating the salesman as to enable him to be of practical operating assistance. This is a more substantial basis to work on than merely to get together to talk over the Dean Company's own particular ambitions.

The new medium of transmitting these several items of operating intelligence, is the well-informed Independent salesman



Eastern Sales Staff of the DEAN ELECTRIC Company—Annual Sales Meeting, 1909.

THE ELECTRICAL VEHICLE BUSINESS.
Meeting to Be Held at San Francisco.

Meetings of those interested in the development of the electrical vehicle business will be held under the auspices of the Electric Storage Battery Company, manufacturers of the Exide battery, at the Hotel St. Francis, San Francisco, on February 19th and 20th. Papers will be presented on batteries, vehicles, motors, arc rectifiers, and other subjects, the complete program to be issued later.

The reading of the papers will be followed by discussions in which all present will be invited to participate. It is expected that the discussions will bring out a fund of information valuable to all.

The opening session will begin at 10:30 o'clock Friday morning, February 19th.

The electric vehicle both for pleasure and business is no longer an experiment. The power companies furnishing electric power in the larger cities will undoubtedly appreciate the opportunity offered not only of increasing their output, but of improving their load factors by furnishing current for charging automobile batteries, and should be interested in a conference of this character. That the business will receive a stimulus by periodically bringing together those who will mutually profit by it is without question.

It is expected that representatives of manufacturers and vehicle distributors, and central power stations from Los Angeles, Portland and Seattle, will be present, and an invitation is cordially extended to those who are interested in the object for which the conference is called.

WHEELER CONDENSING APPARATUS ON THE COAST.

C. H. Wheeler Manufacturing Company of Philadelphia, have an office in the Monadnock Building, San Francisco, in charge of Mr. Frank R. Wheeler. This Company builds steam, electric and power driven pumps, both for pressure and vacuum; also surface, barometric and jet condensers, feed water heaters and water cooling towers.

In connection with the Palace Hotel power plant there is being installed Wheeler condensing and vacuum apparatus including a cooling tower and two ten foot fans. Complete apparatus has also been furnished the Pacific Fruit Express for stations at Colton, Las Vegas and Roseville, for the People's Water Co., in Oakland, and for the Golden State Portland Cement Co., at Oro Grande.

NEW OPERATOR'S RECEIVER.

Many receivers heretofore manufactured, have been found wanting in one respect or another. A good many troubles have arisen, among which, might be noted excessive weight and unsanitary head bands, which short circuit the receiver terminals when thrown back; fittings which are continually catching in the operator's hair; exposed metal parts improperly insulated from the circuit; no provision for attaching strain cord or protecting the conductors; trouble in removing and replacing cord tips; failure to securely fasten all parts to the shell; no provision for using standard cord tips; loss of magnetism; difficulty in remagnetizing, etc.

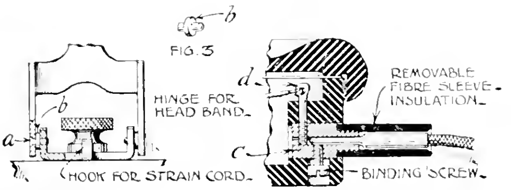
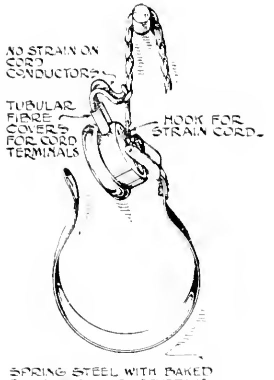


FIG. 1 FIG. 2

After carefully studying every pattern on the market and noting all of the objections that could possibly arise, the Dean Electric Company has perfected a new head set, which has lately been placed on the market. The weight has been cut down by omitting all unnecessary material. The new head band is both sanitary and serviceable. By properly comparing the magnets and windings, the efficiency has been brought up to a remarkably high point. Furthermore, the permanency of the magnets is assured by employing a special imported steel, the same as is used in standard precision volt meters and ammeters.



SPRING STEEL WITH BAKED RUBBER ENAMEL COVERING—CLEAN—DURABLE—SANITARY.

The most permanent feature—the head band—is constructed from spring steel which is covered with a vulcanized rubber. This material gives a remarkably elastic and durable finish, and one which may be cleaned with a damp cloth. This feature avoids the great objection to the interchange of head gears among operators. As shown in Figs. 1 and 2, provision is made for attaching the head band to the receiver. Instead of using a plain or shouldered pin for a pivot, a special turned piece is made from solid stock as illustrated by *b*. One end of this pin is riveted into the band at *a*, while the other forms a pivot. When once assembled, this construction is permanent and the hinged portion securely holds the pin in place even when loosened through rough usage.

Another valuable feature is the cord binding post, which is designed to take a standard cord tip and keep all metal parts entering into the circuit, completely insulated. A fibre sleeve is threaded over the end of the binding post *c*, Fig. 2, so as to enclose the body of the cord tip and thoroughly insulate it as well as to keep it from becoming bent through rough handling. The binding screw can be reached from the outside of the receiver casing without removing the ear cap, and its head is set below the surface of the rubber a sufficient distance to prevent the operator's hand from coming in contact with the circuit.

Another detail which is appreciated by the exchange manager, is the hook which is formed in the back of the case for holding the strain cord. This permits the receiver to be hung up by the cord without damaging the terminal connections and does away with one of the largest items of cord maintenance.

The outer case is made very strong from hard rubber of heavy cross section, while the current carrying parts are insulated from the surface, so that it is impossible for the operator to receive electrical shocks.

Everything considered, this new receiver is a typical Dean product, made with a view of obtaining the highest efficiency and the reduction of the maintenance cost to the lowest limit.

ANOTHER EMERGENCY INSTALLATION.

An example of rapid telephone switchboard installation was again given by the Western Electric Company at Franklin, Pennsylvania, recently. A fire broke out in the building in which the exchange was located early in the morning of November 17th and in a few hours the city was without any convenient means of communication.

Before the fire had burned itself out an order was wired the Pittsburg house of the Western Electric Company to furnish as soon as possible the means by which Franklin might again have telephone service.

A number of emergency boards, which Western Electric houses always have on hand, were set up in the city in about forty-eight hours after the fire, which supplied the needs of subscribers until a new switchboard was put in service.

Renewing a telephone service in a little over forty-eight hours after a main exchange has been totally destroyed is quick work, particularly when the emergency boards have to be sent about 150 miles. But what is to be commended most is the fact that on the evening of the day the emergency boards were received from Pittsburg a car of switchboard material was received from the Western Electric manufacturing plant at Hawthorne, Illinois.

Mr. M. H. Buehler, general manager of the Central District Printing and Telegraph Company, expresses his appreciation of the speedy and efficient work in a letter to President H. B. Thayer of the Western Electric Company, which reads in part as follows:

> "I beg to thank you for the very prompt and efficient aid rendered us in restoring service to our Franklin, Pennsylvania, subscribers, the credit of which is due largely to your efforts, and the prompt manner in which you looked after our needs."

The many Pacific Coast friends of E. L. Wayman, formerly manager of the California Electrical Works, San Francisco, will be glad to know that he is meeting with great success in his management of the Seamless Steel Bathtub Company, manufacturers of pressed steel bath tubs and other sanitary ware, at Detroit, Michigan. They announce a recent connection with Mr. Harman S. Salt, of 114 Liberty street, New York, under which Mr. Salt will have charge of their interests in the East. Mr. Salt was also connected with the California Electrical Works in years past.

CALIFORNIA OIL FIELDS.

Within the last year and a half four bulletins, descriptive of five of the California oil districts, have been issued by the United States Geological Survey. Work has been continuous in these fields, including that of the past summer, which is described in this newspaper report. The bulletins above mentioned are Bulletin No. 309, The Santa Clara Valley, Puente Hills, and Los Angeles Oil Districts, Southern California, by George H. Eldridge and Ralph Arnold; Bulletin No. 317, Preliminary Report on the Santa Maria Oil District, Santa Barbara County, California, by Ralph Arnold and Robert Anderson; Bulletin No. 321, Geology and Oil Resources of the Summerland District, Santa Barbara County, by Ralph Arnold, and Bulletin No. 322, Geology and Oil Resources of the Santa Maria District, Santa Barbara County, California, by Ralph Arnold and Robert Anderson.

These reports are issued in octavo form with paper cover; the text is devoted to more or less detailed descriptions of the geology of the areas under discussion, especially as it relates to the occurrence of the petroleum; descriptive details of the productive areas, such as lists of the oil companies operating, number of wells owned by each, the thickness of the various sands, depth of the wells, quality and quantity of the oil produced, and other useful data, including chemical analyses of the oils made by the survey and conclusions by the oil geologists concerning the areas in which the indications appear best for further development. Supplementing the text are geologic and land line maps of the districts, and, where the data have warranted it, maps showing the underground geology by means of contours; photographs illustrating certain striking features of the geology or development; and, in Bulletins 309, 321 and 322, plates illustrating the fossils characteristic of the various formations encountered in the region. By means of these fossils it is possible to identify the formations in adjacent regions where the geology has not been mapped.

During the summer 1907 the United States Geological Survey undertook the topographic mapping of the southwestern side of the San Joaquin Valley from the Coalinga District, in Fresno County, south to the Sunset District, in Kern County. This work was under the general direction of R. B. Marshall, Geographer, and parties in charge of E. P. Davis, George Davis, R. M. La Follette, J. E. Blackburn and J. W. Miller, were engaged in the work, which was completed in the early part of the present year. The map will be issued in two sections, one covering the territory from Coalinga to Dudley, Kings County, and the other embracing the remainder of the region south to the Sunset District. A few photolithographic advance sheets of both sections have been distributed at advantageous points, such as the postoffices and offices of the larger oil companies and ranches throughout the District, where they may be consulted by the public. On these maps the position and shape of the hills and valleys are shown by contour lines, each of which represents a certain elevation above sea level, and the streams, roads, houses, and section and county lines are shown by conventional signs. The contour interval is 100 feet and the scale of the map is approximately two miles to the inch.

Topographic mapping similar to that done in the region from Coalinga to Sunset is now being carried northward from Coalinga to connect with the areas shown on maps already issued covering the vicinity of San Francisco Bay. This new map will probably form the basis for geologic work similar in character to that done in the Coalinga-Sunset territory.

Simultaneously with the topographic mapping of the region from Coalinga southward to Dudley, geologic mapping and investigations of the oil resources of the same area were carried on in the summer of 1907, by Ralph Arnold and Robert Anderson. The results of their work have been embodied in two reports on the district. One entitled "A Preliminary Report on the Geology and Oil Resources of the Coalinga District, Fresno and Kings Counties, California," has been issued as Bulletin No. 357. It contains a condensed account of the geology and oil resources and is accompanied by black and white maps, one showing the surface geology of the whole region and the other the underground geology of the proved territory of the Coalinga field. A more extended account of the geology, illustrated by engraved maps, sections, photographs and plates of characteristic fossils, and accompanied by a table of over 50 analyses of the oils by Irving C. Allen, of the Geological Survey, will be issued later, also as a bulletin for free distribution. The work of Messrs. Arnold and Anderson has also been made the basis for the classification of the public lands in the Coalinga District as mineral or non mineral, reported to the General Land Office.

During the summer of 1908 a United States Geological Survey party, consisting of Ralph Arnold and H. R. Johnson, carried geologic investigations southward from Dudley to the Sunset oil district, the territory covered embracing the Devil's Den, Bitterwater, Temblor, McKittrick, Midway, Sunset, and Carrizo Plain districts. Reports similar to those relating to the Coalinga district will be prepared for this new region. The preliminary bulletin is expected to be ready for distribution by next spring.

Copies of Bulletins 321 and 357, and a list of the publications of the Survey may be obtained free by addressing a request to the Director, U. S. Geological Survey, Washington, D. C. Bulletins Nos. 309, 317, and 322 are now out of stock for free distribution, but may be obtained from the Superintendent of Public Documents, Washington, D. C., for 80c, 15c and 50c, respectively. Persons desiring copies of reports not yet issued will, on request, be placed on the mailing list for the bulletins.

WIRELESS OPERATOR STRUCK BY LIGHTNING.

Lightning is an infrequent phenomena on the Pacific Coast, but in the thunder storm which took place at 4:30 o'clock on the morning of February 7th, the equipment of the Massie Wireless Station near the Cliff House at San Francisco, was struck by a bolt which destroyed the equipment and seriously injured Wm. J. Smith, western manager for the company, who was acting as operator at the time.

While Smith was communicating with the Lurline, he was suddenly enveloped with a flash and was rendered unconscious, burning mementoes of the experience being imprinted on the flesh of his arm, chest and back.

In discussing his experience, Smith said:

"I was operating the company's station near the Cliff House about 4:30 o'clock this morning when I received the shock. The instant before I was in communication with the Lurline. The working conditions were splendid and I, with the receivers over my ears, had just sent a message to the vessel at sea when this great flash filled the station.

"Several times before in my experience I have received electrical shocks of greater or less severity, but never one that had the effect this lightning flash did. The scars that I have to show for my experience with lightning are peculiarly adapted to make me remember this adventure.

"It is rare that such an experience is had. In the West, along the coast, electrical storms are rare. We have not been prepared for them. In the East we have adequate apparatus to protect the appliances. The mast and the wires acted as a lightning rod and I got the full benefit. I am thankful that I was not killed."

The Heroult electric furnace has replaced crucible furnaces for the manufacture of tool steel at the Obonkhoff Steel Works near St. Petersburg. This is the first electric furnace to be installed in Russia.

A San Francisco wharf builder has discovered that teredoes may be driven from piling or other water timber by passing a weak electric current through the wood.

NEWS NOTES

TELEPHONE AND TELEGRAPH.

EXETER, CAL.—The Davis-Brown Company is building a new telegraph line in this city.

VANCOUVER, WASH.—The Minnehaha Co-operative Telephone Association has been granted a franchise.

CAMAS, WASH.—The city council has granted H. S. Parker a franchise for a telephone system for a period of 25 years.

ANACORTES, WASH.—The Farmers' Mutual Independent Telephone Company has been granted a franchise by the county.

ENAVILLE, IDAHO. — The North Idaho Telephone have ordered complete a switchboard and telephones for their Enaville plant.

CHEHALIS, WASH.—Extensive improvements and extensions are to be made to the Chehalis and Boistfort Telephone Company.

STEVENS, WASH.—Franchise for Skamania Co-operative Telephone Association for telephone lines along country roads has been granted.

AUBURN, WASH.—The Home Telephone Company of Auburn expects to install a 100-line common-battery switchboard and telephones soon.

SOUTH BEND, WASH.—W. W. Connon of Centralia has purchased the telephone business of the city and has applied for a franchise at Raymond.

HOQUIAM, WASH.—The Pacific Telephone and Telegraph Company has begun the expenditure of $10,000 on the improvement of its lines in this city.

WENATCHEE, WASH.—Extensive improvements are planned by the Farmers' Telephone Company for the present year. Orders will be placed soon for a duplicate power plant.

NEVADA CITY, CAL.—The Pacific States Telephone and Telegraph Company is now securing rights of way for the building of a new line from Sacramento to Camptonville via this city.

SAN FRANCISCO, CAL.—O. W. Lillard, sales engineer of the Gould Storage Battery Company, with headquarters at the Monadnock Building, leaves this week for an extended trip through the Northwest.

EUREKA, CAL.—Superintendent Ed. McLaren, of the Pacific States Telephone and Telegraph Company, announces that the company is to begin building the long talked of road from Eureka to Crescent City.

The Eastern Oregon Telephone and Telegraph Company has been formed with a capital stock of $10,000, by J. R. Jenkins and others. It is the intention of the company to put a line from Burns to Lawen.

OAKLAND, CAL.—J. E. McGilvery, formerly representing the American Electric Telephone Company, with headquarters at Oakland, California, has been transferred to the Chicago House, with headquarters at Des Moines, Iowa.

LOS ANGELES, CAL.—A resolution has been passed ordering all telephone and electric wire poles removed and wires placed underground along the speedway from Hollister avenue to the southern city limits at Marine street.

MARSHFIELD, OREGON.—The switchboard and telephones of the Coos Bay Home Telephone Company of Marshfield arrives this week and the installation will be rushed so as to give service at the earliest possible time.

LOS ANGELES, CAL.—Secretary F. W. Eaton, of the Pacific Telephone and Telegraph Company, reports in his annual statement a revenue of $804,560.38 from local service $16,225.99 from long distance charges and $20,880 from real estate. The total expenses were $867,888.05. The company has $6,111,209.89 invested in its Los Angeles plant.

SAN FRANCISCO, CAL.—The Pacific Auxiliary Fire Alarm Company at its annual meeting re-elected the following directors: Louis Sloss, Geo. A. Moore, L. F. Monteagle, H. A. Hedger, M. H. Hecht, Alfred B. Ford and W. Hansen. The directors organized by re-electing Louis Sloss, president; Geo. A. Moore, vice-president, A. G. McFarland, Secretary.

PLYMOUTH, CAL.—The telephone exchange at Plymouth was recently destroyed by fire. Through the active and efficient management of Mr. E. H. Gardner, under whose control this office is conducted, toll connections were resumed within five hours after the fire and 72 subscribers were working on temporary boards at a new location the next day.

FARMINGTON, UTAH.—The equipment for the Davis County Telephone Company of Farmington arrived this week. Active installation will be begun at once. It is interesting to note that the equipment purchased for this company includes the very best common battery multiple type circuits and each town will be thoroughly equipped for the harmonic four and eight party service.

OAKLAND, CAL.—J. P. McCarty, inventor of a wireless telephone, has been making demonstrations in the Bacon Building of this city. He is reported to be able to transmit his voice through eight walls, a distance of 125 feet, and be heard distinctly. Although the instrument is crude Professor Elwell of Stanford University will, it is understood, give the instrument a thorough test.

LOS ANGELES, CAL.—President A. B. Cass, of the Home Telephone Company, reports that $745,189.66 was received during the year for rent and service in the city and $16,787.97 outside the city. Running expenses and depreciation amounted to $668,952.94. Expenses for construction and improvements were $305,821.75. The company has $6,185,045.02 invested in the city and $239,771.64 outside the city.

ANACORTES, WASH.—The installers from the Dean Electric Company have arrived in Anacortes and active work on the installation of the plant for the Farmer's Mutual Independent Telephone Company, Everett, Wash., will begin at once. The Anacortes board is of the full common battery multiple type and was shipped within thirty days from receiving telegram notifying the Dean Company to start work on the switchboard.

TURLOCK, CAL.—On November 1st the Turlock Home Telephone Company took over the Turlock exchange under a sublicense contract. A number of the business men of that town have taken hold of the exchange and in one month the new company has ordered twenty-five additional telephones, bringing the total number of subscribers in the exchange up to 305. The Turlock Home Company expects to spend approximately $1,500 in new construction and reconstruction in Turlock and will undoubtedly have a first-class plant on a splendid paying basis.

SAN FRANCISCO, CAL.—One of the first accidents of its kind ever known occurred at the Massie Wireless Company's station near the Cliff house during an electrical storm which visited this city early on the morning of February 7th, when William J. Smith, Western manager of the concern, who was operating the mechanism at the time was seriously burned and narrowly escaped being killed by an electric shock that struck the apparatus.

SAN FRANCISCO, CAL.—The Pacific Telephone Company in connection with the fixing of rates has submitted its annual statement to the board of supervisors. The local franchise of the company is valued at $450,000. The total value of its plant and franchise is estimated at $7,218,269.82. The total gross revenue last year was $2,119,416.12, made up as follows: Local receipts, $1,951,123.09; long distance, $63,033.03; real estate returns, $105,260. Its total expenses amounted to $1,602,000.

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Canaros Oil Company has been incorporated here with a capital stock of $400,000 by F. N. Kimble and E. Hirschler.

SANTA ANA, CAL.—The Orange Gas Company has been incorporated here with a capital stock of $200,000 by D. L. Peters, M. L. Bellus, J. W. Kemp, E. B. Rhoades and J. S. Mitchell.

LOS ANGELES, CAL.—The Oliveta Water Company has been incorporated here with a capital stock of $6,000 by G. E. Daniel, Ferd Girker, E. O. Bailey, David Moyer and A. E. Dombrower.

SAN FRANCISCO, CAL. The Empire Oil Company has been incorporated here with a capital stock of $200,000 by S. A. Gilbertson, H. A. Whitley, E. A. Guilbault, P. J. Muller and L. O. Cannon.

LOS ANGELES, CAL.—The Electric Dispatch Company has been incorporated here with a capital stock of $50,000 by G. C. Ward, H. E. Huntington, G. J. Kuhrts, S. M. Haskins and J. A. Gibson Jr.

SAN FRANCISCO, CAL.—The Black Mountain Land and Water Company has been incorporated here with a capital stock of $1,500,000 by Duncan Hayne, A. H. Redington, E. W. Howard, J. A. Hoey and A. D. Keyon.

TRANSMISSION.

EL CENTRO, CAL.—Work has commenced on the new power plant of the Holton Power Company at Holtville.

OAKLAND, CAL. — The California Electric Generating Company has applied for a building permit to construct a power station in the Sessions Basin in East Oakland. The building is to be made of steel and concrete and the estimated cost is $50,000.

CITY OF MEXICO, MEXICO.—A company is to be formed here with a capital stock of $10,000,000 by Paul Ginther, president; Juan Creel, treasurer and Lic. Joaquin Gortazar, secretary. The company proposes to build an electric light and power plant within a few miles of Santa Rosalia on Rio Conchas.

FRESNO, CAL.—The San Joaquin Light and Power Company has begun work on the extension of its power lines to eight valley towns, namely: Sanger, Clovis, Pollasky, Malaga, Sultana, Orosi, Parlier, Lemoore and probably Conejo. The power will be supplied from the generating plants of the power company on the San Joaquin River. General Manager Balch and a number of Eastern capitalists have visited Fresno and all have expressed their approval of the extension.

SACRAMENTO, CAL.—George P. Robinson, of Fair Oaks, has secured a bond on the property and stock of the North Fork Ditch Company for six months, the price being $350,000. Mr. Robinson is acting for Minnesota capitalists, who propose to build a road from Sacramento to Lake Tahoe, and it is believed that the water taken from the north fork of the American River will be used for power and irrigation purposes. Water rights have already been purchased on the American River in Placer county, near Auburn, and water for irrigation is being supplied to Fair Oaks and Orangevale in this county.

FINANCIAL.

LOS ANGELES, CAL.—The Pacific Light and Power Company shows receipts amounting to $1,780,101 and expenditures of $1,400,293. The value of its property and assets is given at $7,574,431.15.

SAUSALITO, CAL.—The $100,000 worth of bonds issued by Sausalito to defray the cost of installing a municipal water and distributing plant was awarded to G. G. Blymeyer & Co., of San Francisco.

LOS ANGELES, CAL.—The Domestic Gas Company, having 6,796 customers, reports receipts of $41,751, and expenditures of $44,207, and the value of its property $115,169. It manufactured 61,147,000 cubic feet of oil and water gas.

LOS ANGELES, CAL.—The Edison Electric Company shows receipts of $1,040,390.53, expenditures $646,912.21, and net earnings $393,478.32. It sold during the year current amounting to 56,916,805 kw. hours. It gives its property and assets at a value of $6,022,132.75. Its total receipts in the five counties in which it operates are shown to be $2,011,816.54, and its expenditures $1,208,273.85.

LOS ANGELES, CAL.—The Los Angeles Gas and Electric Company, with 55,366 customers, reports receipts of $1,881,855 and expenditures of $1,521,751, leaving a profit-and-loss balance of $360,100. During the year it manufactured 2,386,440,000 cubic feet of oil and water gas. The largest output in one day was 10,816,140 feet and the lowest 3,722,000 feet. The property and assets are valued at $6,110,308 in the city and in addition there is property in the county valued at $209,923.

OIL.

SANTA BARBARA, CAL.—The Union Oil Company and the Associated Oil Company suffered great losses during the past week by the breakage of their pipe lines across the Santa Maria and the Santa Ynez Rivers. The great torrents of flood waters that have come down these rivers are the cause of the loss.

McKITTRICK, CAL.—The Jewett Company, which has the Kern River lease, have found an interesting well. It is 1,070 feet in depth, has 175 feet of oil bearing formation, and the casing is landed in a bed of solid asphaltum. This is something new in McKittrick, and speculators are of the belief that still lower down there is another oil sand, for it is thought that the asphaltum came from seepage below and not from the oil above. The members of the company are deeply impressed and have undertaken the digging of a deep hole to test the levels below the asphaltum.

WATER.

BAKERSFIELD, CAL.—R. E. McCauley, of the National Supply Company is promoting a scheme whereby the entire West Side district of Kern county will have an abundant supply of pure water within a year. The supply will come from Ray's creek in Pine Mountain, forty miles almost due south of Midway, and will be piped by gravity and delivered to con-

sumers at about 4 cents a barrel. An eight inch pipe will be used at the intake and smaller sizes on the main. The pipe line will be capable of delivering 20,000 barrels a day, which is the minimum carried by Ray's Creek at any time in 30 years. Not only Midway, but also Sunset, McKittrick and Temblor will be supplied. If the demand is sufficient pipes can be laid into Devil's Den, where water is scarce, and into Kings county. The cost of the installation will be more than $350,000.

TRANSPORTATION.

PLACERVILLE, CAL.—W. P. Hyatt has filed notice of appropriation of 2,000 inches of water in the North Fork of the Cosumnes River for power purposes.

LOS ANGELES, CAL.—The trustees of Huntington Park have taken into consideration the offer of the American Steel Pipe Company to put in a water plant for $40,000 to supply a population of 6,000.

SAN FRANCISCO, CAL.—A satisfactory settlement has been made between the Government and the owners of the Truckee River General Electric Company regarding damage at Lake Tahoe, and no suits will be brought by the Government.

GALT, CAL.—The citizens of Woodbridge have offered the Central California Traction Company a free right of way to extend its electric line from Lodi to Woodbridge. Elbert Covell and Fred Parrott, representing the residents of Woodbridge, have consulted General Manager Sam B. McLenegen in regard to the extension and the company has declared its intention to begin work on this project soon.

BERKELEY, CAL.—The Oakland Traction Company has begun the construction of its new cross-town line on Ashby avenue running from the new Claremont Hotel at the head of Russel street west as far as San Pablo avenue, about two and a half miles. The work will be completed in about forty days. The new cross-town line on Dwight way, one half mile further north, running from College avenue to Sixth street, is now in operation.

ALAMEDA, CAL.—Investigations of the local steam lines have been made during the past week by Electrical Engineers Moulthrop, Cahey and Clapp, representing the Southern Pacific Company, preliminary to the installing of the electric traction system which is to supplant the present steam system. The company proposes installing ornamental trolley poles in the center of the streets over which its trains will run. The city officials who accompanied the engineers were assured that the roads would be electrified and in operation within a year. All that is delaying the beginning of the work is the securing of a right of way for the connecting loop at the east end of the city.

ILLUMINATION.

LOS ANGELES, CAL.—Watts F. Helm, of Los Angeles, has asked for a franchise to erect a gas plant in this vicinity.

SANTA ANA, CAL.—The Orange County Gas Company has bought the gas works of W. L. Willets and will install a new gas holder with a capacity of 50,000 feet of gas.

LINDSAY, CAL.—President Chas. Burn, of the Lindsay Gas Company has returned after investigating a number of gas plants in the south and work will be soon under way for the erection of a gas plant at Lindsay.

LOS ANGELES, CAL.—Investigations of the tide lands in the vicinity of Long Beach are being made by Engineer F. C. Jones and several others for the Edison Electric Company, of Los Angeles. The company intends to erect a $1,000,000 gas plant in this vicinity to supply all cities of the south, except San Diego, with gas.

AMERICAN TELEPHONE AND TELEGRAPH SYSTEM CONNECTS WITH 1,000,000 NEW STATIONS DURING THE PAST TWO YEARS.

One of the most important features of telephone development in 1908 was the large increase in the number of independent companies with which connections were established by the Bell Company. During 1907 the Bell companies established toll and long distance connections with no less than 450,000 independent telephone stations throughout the country. The number taken over last year was practically as great.

As a result of the 1907 and 1908 development in this direction the American telephone and telegraph system now embraces a total of over 4,000,000 stations, of which 1,000,000 represent stations of small independent companies not owned outright but connected with the Bell lines. Five years ago there were considerably less than 100,000 of these independent stations so connected.

The independent stations are nearly all in rural districts, were installed by local people and were operated along provincial lines until the American Telephone and Telegraph Company saw fit to widen the scope of its public usefulness and made these companies a part of its own 3,000,000 odd stations.

These connected stations represent at least 5,000 companies commonly classed as "independents," but which in everything except local service are a part of the Bell system.

An electric duck-feeder is said to have been devised by an Arizona genius who noticed that an electric light attracted bugs which domestic ducks regard as a delicacy. By placing the light in the center of a pond the ducks are able to feed upon the insects as they fall into the water.

The little town of Woodbury, Conn., has a population of 2,000 people and was named in 1674. It is a modern town in every respect, prosperous in a manufacturing way, and blessed with an electric lighting plant of most modern design, but up to within the past few months it has depended for transportation of both feight and passengers on the old fashioned stage coach and freight wagons. This condition was recently changed when the new trolley line running from Waterbury to Woodbury, for which a charter was secured sixteen years ago, was formally opened and a car containing President Mellen and other officials and directors of the New York, New Haven & Hartford Railroad and Connecticut Company rolled into the town about noon. The car was greeted with cheers, blowing of whistles and ringing of bells, as the citizens saw in its coming the passing of the stage coach period. The formal exercises included a speech of welcome by Asa W. Mitchell and a response by President Mellen.

European Water-powers, according to a German engineer, Otto Mayr, total 34,151,600 h. p. Norway leads with 7,525,000 h. p. available, of which only 301,000, or 4 per cent is utilized; Sweden follows with 6,750,000 h. p. available and 200,000, or 2.9 per cent used; Italy, with 5,500,000 h. p. available, and 464,000, or 8.43 per cent, used; France, 5,524,000 h. p. available, and 1,190,800, or 21.50 per cent, used; Austria, 5,125,000 h. p. available, and 450,000, or 8.78 per cent, used; Germany, 1,677,600 h. p. available, and 503,300, or 30.01 per cent, used; Switzerland, 1,500,000 h. p. available, and 380,000, or 25.33 per cent, used; and Hungary, 550,000 h. p. available, and 65,000, or 11.81 per cent used. These figures give a total of 34,554,100 h. p., or 10.41 per cent, is utilized. They are, however, only a rough approximation, as, in the case of Italy and Switzerland, the data are brought down to the end of 1905 only, and in the case of France and Germany they are for the year 1907. With regard to Italy, the Giornale dei Lavori Publici remarks that at the end of 1906 the water-power used totalled 830,000 h. p., or a percentage of 15.27 per cent. Of this 830,000 h. p., 740,000 was transformed into electrical energy and 90,000 applied directly.

TRADE MARKS

lassified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public — the consumer — who will listen with a willing and eager ear to the story of quality.
Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

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INDEX TO ADVERTISEMENTS

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the **Journal of Electricity Power and Gas** *604 Mission Street, San Francisco.*

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Stanley & Patterson, Inc., "Sunlight."

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Okonite Co., "Okonite."
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Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

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Star Porcelain Co.
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Weber Elec. Co., H. D. Sears, general sales agent.
Western Elec. Co., "Thomas"

WOOD KNOBS
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Western Electric Co.

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BOILER COMPOUNDS
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Johns-Manville Co., H. W., "Magic."

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Sprague Electric Co., "Greenfield."

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American Circular Loom Co., "Electroduct."
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Kierulff, B. F., Jr. & Co., "American."
Roeblings Sons Co., J. A. "Navalite."
Cole Co., John R., "Electroduct."
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General Electric Co.
Okonite Co., The, "Okonite."
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Roeblings Sons Co., John A.
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Simplex Elec. Co.
Std. Elec. Wks., "Simplex."
Standard Und. Cable Co.
Western Elec. Co., "Victor."

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Fairbanks, Morse & Co.
Ft. Wayne Electric Wor
General Electric Co.
Standard Electrical W "E. M. Co."
Western Electric Co.
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Electric Appliance Co., "onial."
Fairbanks, Morse & Co.
Ft. Wayne Electric Wor
General Electric Co.
Northern Electrical Mfg.
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Kierulff, B. F., Jr. & "American Diesel Eng
Tracy Engineering Co.
Westghse Machine Co.

MARINE ENGINES
Standard Elec. Works, " bery."

STEAM ENGINES
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Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Wes house."
Tracy Engineering Co., T
Westghse Machine Co.

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DESK AND BRACKET ALTERNATING CURRENT FANS
Ft. Wayne Electrical W
General Electric Co., "G
Standard Electrical W "Jandus."
Western Elec. Co., "Vic "Emerson."
Westghse Elec. & Mfg.

EXHAUST FANS
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Wagner Electric Mfg. C
Western Elec. Co., "W.
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Standard Elec. Wks., " dus," "Century."

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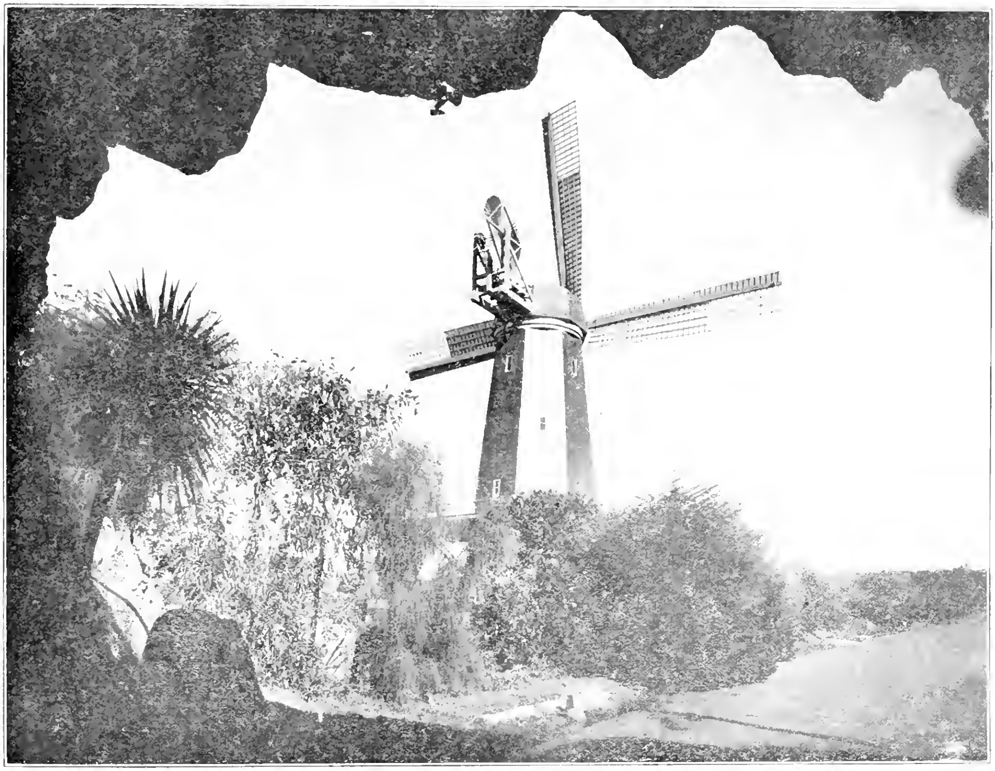
THE LARGEST WINDMILL IN THE UNITED STATES

Several years ago a Dutch windmill was built in Golden Gate Park, San Francisco, close to the tossing waves of the Pacific. So picturesque was its appearance and so successful its operation that its mate has been recently constructed several hundred feet to the south. These are the two largest windmills in the United States, the original having a diameter of 102 feet and the new of 114. The sweeping arms of these transplanted scions of Holland greet the mariner entering the harbor of San Francisco from the Pacific. They pump water for the various artificial lakes in which this great park abounds.

The powers of Nature are valuable in proportion to their economy and their dependability. There is probably nothing cheaper than wind, and nothing as unreliable. But in this case the trade winds from the Pacific spring up about the time the dry season begins and blow a steady gale until the fall rains set in; their gentle insistence drives this great mill and pumps much of the water required during this period of natural drougth. With their utility and dependability proven by use, they combine the rare quality of being both useful and ornamental.



View of Dutch Windmill in Golden Gate Park, San Francisco, From Within Tunnel Under Roadway.

The new mill is larger in every respect than its predecessor which was described in this journal in March, 1905. It stands 85 feet from the ground to the centre support of the arms, these having a further radius of 57 feet which gives a total height of 142 feet. Their tower support is essentially a truncated, octagonal pyramid, substantially built and covered with slate. The base is constructed of concrete strongly reinforced with steel

rails. The basal diameter is 60 feet gradually diminishing to 24 feet at the turret top. Within this five storied tower, whose walls taper from a thickness of four feet at the base, is placed a great pump, having a capacity of 60,000 gallons hourly. Each story of the structure supports the verticle shaft which transmits the power from the windmill to the pump.

The four arms, or sails, of the mill turn a great steel shaft, twenty-two feet long and thirteen inches in diameter to which they are attached by a heavy iron hub. Each of these arms consists of a long spar of Oregon pine, upon which is mounted wind-boards and sails to give an effective wind area of 516 square feet for each arm, making a total of 2064. This maximum may be considerably reduced by furling the canvas in case of high winds. A small steering wheel with a diameter of sixteen feet keeps the power wheel always in the wind, just as the helmsman controls a ship by the rudder. The steering wheel stands at right angles to the large mill so that its blades receive no energy as long as the large mill is directly to the wind. Should the wind direction shift ever so slightly, the small wheel turns and pulls the power mill into the wind again, its motion being transmitted through four sets of gears to the revolving turret, giving a proportion of 7500 to 1. A double band brake, lever operated, has been substituted for the half brake of similar type, which proved insufficient to hold the mill, if it was to be stopped.

Experience in Holland has shown that a maximum of power is obtained with a slight elevation of the axis above the horizontal, and consequently the main shaft has been mounted at an angle of twelve degrees thirty minutes. The power varies with the velocity of the wind and the extent of sail areas. The following table has been compiled for the various wind velocities at a maximum sail area:

Miles per hour.	Horse power.
4	0.383
6	1.283
8	2.193
10	5.953
11	7.473
12	10.32
14	16.35
16	24.37
18	31.65
20	47.63
25	92.91
30	160.75
40	381.08

These results are theoretical. The sails are furled as the wind velocity exceeds 20 miles per hour.

The power is transmitted by gearing through the vertical shaft to the pumps. These are two vertical, single-acting, triplex, plunger pumps, built by George E. Dow Pumping Engine Company of San Francisco. The plungers have a diameter of ten inches with a twelve inch stroke. The new mill has not yet been put into practical operation but has a rated capacity of 1,000 gallons per minute.

The water is pumped through a 14-inch suction nozzle from a great sump that collects the seepage and run-off of the surrounding country. Although this sump is within one hundred feet of the beach, its water is always fresh, because the hydrostatic pressure of the ground water is greater than that of the sea water.

Government engineers have recently concluded a series of experiments on the pumping capacity of the older pump and as soon as these are available the report will be published in these columns. It is roughly estimated that the cost of the pumping is about three cents per thousand gallons.

This windmill has been furnished through the generosity of the late Mr. Samuel G. Murphy of San Francisco, a former Park Commissioner and President of the First National Bank. This mill, like its predecessor, was designed by Mr. J. C. H. Statt and was installed under the direct supervision of Mr. J. Dakenran, Superintendent of the Golden Gate Park Water Works, and under the general supervision of Mr. John McLaren, Superintendent of Golden Gate Park. Mr. McLaren is so well pleased with the landscape effect and with the pumping performances of these two mills that he hopes to have several more built along the ocean frontage to supplement the work of the main steam pumping plant.

PRIME MOVERS.[1]

BY CHARLES P. STEINMETZ.

I.

Electric energy is not a primary energy; that is, it is not found in nature, nor directly producible to any appreciable extent from the stores of energy available in nature—water power and the energy of fuel. To become available for conversion into electric power, the energy found in nature must first be converted into mechanical rotation by some form of prime mover. The engineering characteristics of these converting apparatus may be classed under two main groups, those referring to economy and reliability, respectively. In both, the electric machine, whether generator or motor, ranges very high; its efficiency is virtually unity; its size, first cost, and maintenance small; its reliability great. In the cost of electric power the electric machine plays only a subordinate part; the essential element in determining the cost and the reliability of electric power is the prime mover; that is, the intermediary step between nature's stores of energy and the dynamo shaft.

The cost of electric power consists of three parts.

A. The fixed cost or permanent cost; that is, the cost depending on the size of the station, but not on the amount of power supplied by it.

B. The proportionate cost; that is, cost proportional to the amount of power delivered.

C. The reliability insurance; that is, the additional cost required to assure the desired reliability or continuity of service.

A. Fixed Cost.

1. *Interest on the investment in the plant.* This factor varies very greatly with the form of the available energy. It is frequently very large with water power, due to the hydraulic development required—dams, pipe-lines, land to be flooded for water storage, power stations and prime movers, transmission lines, etc.

It also depends on the prevailing rate of interest; on local conditions—whether a market is waiting for the power and capital for the development easily obtained; whether a market is within reach and can be developed; or whether a market has first to be created.

2. *Depreciation of the plant.* This factor is different for different parts of the plant. For instance it is very low for buildings and for line copper; it is high for apparatus such as railway motors, which by the nature of their service operate on a narrow margin.

In considering depreciation, the "useful life" of the apparatus may often be much shorter than the total life. The ratio of the useful life to the total life varies with different apparatus. Electrical machines and prime movers and other parts of the plant, for instance, may still be in condition to give many years' service, but nevertheless their further use is uneconomical. Their useful life is thus ended. This condition may be due to the advance of the art, which makes other types of apparatus so much more economical that the cost of the difference in economy properly capitalized exceeds the cost of reconstruction of the plant. It may be due to the fact that with the increase of the market the size of units initially chosen may have become too small, or the space-economy too low, or the voltage too low for economy. Furthermore, the cost of attendance or of maintenance may be so much lower with the more modern apparatus as to make it uneconomical to retain the existing plant.

Just as it was realized many years ago that with the incandescent lamp there was a difference between the total life and the useful life, that after a definite period it did not pay to maintain incandescent lamps in service, even if still operative; so with all engineering apparatus a similar "smashing point" exists, a point where economy requires renewal of the plant, even if still operative. At this point the useful life of the old plant ble either by use as reserve plant, or to take care of peak loads,

[1]Extract from a paper presented at the meeting of the American Institute of Electrical Engineers, New York, February 19, 1909.

is ended; it should be thrown out with whatever salvage is feasi- or to be operated elsewhere when space economy limits the useful life. In considering depreciation, the useful life of the apparatus should thus be considered.

3. That part of the operating expense which does not depend on the use of the plant, as superintendence, some supervision, etc., such repairs as maintenance of dams and hydraulic development, etc.

B. Proportionate Cost.

1. This comprises the cost of energy and accessories to its conversion—fuel, condensing water and lubricating oil in thermodynamic engines, water (where a charge is made for the water power) and oil in hydraulic plants, etc.

2. Labor and attendance, including that part of supervision which varies with the power utilized.

3. Maintenance, repair and depreciation of the plant, as far as they depend on the use of the apparatus; for instance, brush renewals, commutator repairs, railway motor depreciation, etc.

C. Reliability Insurance.

1. This comprises the overload capacity of apparatus in power, voltage, etc., provided to take care of emergencies.

2. Duplication of parts of the plant, as reserve units, duplication of exciter plant, of lines, and feeders, etc.

3. Additional plant, as steam reserve with water-power plants, storage-battery reserve, tie lines with other systems, etc.

Some of the items of the cost may belong partly in one, partly in the other class; depending on local conditions, it may properly be chargeable to either one or another subdivision. For instance, the cost of developing water storage would belong under *A*, if the power capacity of the plant depends on it, while it would be chargeable to reliability insurance *C*, if provided to guard against failure of the power in unusually dry seasons.

The relative weights of *A* and *B* depend largely on the load-factor; that is, the ratio of the average to the maximum power. With a poor load factor, item *A* is far more important. It recedes in importance with the improvement in the load-factor.

Attention is drawn to the recognition of Class *C*, the reliability insurance, as a distinct and essential part of the cost of power, separate from *A* and *B*. Item *C* again consists in part of the character of fixed cost, and in part of the character of proportionate cost. Nowadays, when the lay public is interested in the cost of electric power, and is comparing plants which may be very different in regard to reliability of service (as supply from a water power over a single transmission line without steam reserve compared with a city steam station with storage-battery reserve), it appears desirable to recognize the insurance of continuity of service as a separate part of the cost of electric power.

The great difficulty met with in discussing reliability of service is the absence of an established standard; for what one engineer may consider as perfectly satisfactory service, may be considered as entirely unsatisfactory by another engineer.

A classification of electric power supply regarding its reliability may be made by the number of shut downs per year. Four classes of shut downs may be distinguished, by the time of their duration:

a. Less than one second; that is, less than the time which would throw synchronous apparatus out of step. A few seconds' failure of power in the supply of a synchronous motor or converter means re-starting and synchronizing, and thus for the power users depending on the synchronous machine represents a very much longer shut down.

b. Less than 20 minutes; that is, the time in which synchronous appartus in a well organized plant can be put back into service. In lighting circuits, while the failure of the lights is annoying, it is not usually serious, and the loss of time by failure of the power supply is moderate.

c. Less than three hours; that is, the time sufficient to start anew a steam plant, replace or repair damaged apparatus as transformers, repair lines, etc., and a time which, if the shut-down occurs only rarely, in general does not warrant the installation of a separate system of light and power supply, as gas or a private steam plant.

d. More than three hours. This represents a complete break down of the system. If this is likely to occur, it requires the provision of private lighting or power plant service wherever power is used from the electric supply system.

In estimating the reliability of service the shut down of a part of the system would be considered as a part of a shut down, in proportion to the connected load. Thus a shut down of a section comprising $1/n$ of the total connected load of the system would count as $1/n$ of a shut down. This method of counting gives the average number of shut downs per customer.

Voltage variation beyond the limits permissible in good service—about 2% in lighting, and 10% in power supply—would be considered as a partial shut down, about in the following manner:

A voltage variation of 2 per cent to 10 per cent as one-tenth of a shut down in a lighting system, but does not count in a power-supply system.

A voltage variation of 10 per cent to 50 per cent as one-half of a shut down.

A voltage variation of over 50 per cent counts as a complete shut down.

It appears reasonable to omit from consideration any shut-down made for purposes of change, repair, etc., provided the users have been notified beforehand.

By the yearly number of shut downs, an electric power supply would be classified as:

1. First class service:

$a < 4$ per year; $b < 1$ per year; c and d absent

2. Good service:

$a < 12$ per year; $b < 4$ per year; $c < 1$ per year; d absent

3. Second class service:

$a < 52$ per year; $b < 12$ per year; $c < 4$ per year; $d < 1$ per year

4. Third class service:

$b < 52$ per year; $c < 12$ per year; $d < 4$ per year.

5. Unsatisfactory service, suitable only as auxiliary power, etc.

Some such schedule of classes of service appears urgently needed, to give a meaning to statements and discussions on character and reliability of service.

The above proposition is probably the best that can be expected at present, without putting too large a majority of the electric systems into the second and third classes. It must be realized, however, that the standard set by it is far lower than that maintained in most gas or water supply systems; that what is here called good electric service would be entirely unsatisfactory in a gas service. However, this lower standard is permissible, due to the far greater safety of electric power, in which case a temporary interruption of the supply is not liable to such disastrous results as would be the case with gas service.

II.

In discussing the features of prime movers, it is necessary to distinguish between those which are inherent in the type of apparatus — as the dependence on meteorological conditions in the hydraulic plant, the high temperature in the gas engine—and those which are incidental. The incidental features are due to the particular form of design, and therefore defects from this cause are usually temporary. While a defect in the prime mover may be just as serious to the operation of the plant, even if not inherent in the type of apparatus, in a comparative discussion such features cannot be given the same weight, as they are not permanent. They are eliminated with the advance of the art, or avoided when recognized; as, for instance, the difficulties found with the convection of superheated steam, due to the considerable expansion and contraction of piping caused by the high temperature differences.

Most of the features of prime movers pertain either to economy or to reliability.

A. Economy.

1. *Power of economy or efficiency.* With a thermodynamic engine the total efficiency is the product of mechanical efficiency, thermodynamic efficiency, and producer efficiency. The thermodynamic efficiency is the ratio of the available energy in the engine to the total heat energy supplied to it. The mechanical efficiency is the ratio of the mechanical output at the engine shaft to the available energy in the engine. The producer efficiency is the ratio of the total energy of combustion of the fuel to the heat energy supplied to the engine, it thus comprises furnace efficiency, boiler efficiency, superheater efficiency in a steam engine, or producer efficiency in a gas-producer plant, etc.

The thermodynamic efficiency depends essentially on the temperature range utilized by the engine, and to a lesser extent on the thermodynamic cycle used by it. It increases with increase of the temperature range.

The mechanical efficiency depends on the size per kilowatt output of the cylinder volume, on the temperature range, the pressure and the pressure differences, the momentum of the moving parts, their velocity and the nature of the velocity, whether reciprocating or rotating, etc. In general it decreases with increasing size and mass per kilowatt, with increasing speed, (especially when reciprocating) and with increasing temperature and pressure differences. It thereby depends largely on the available energy per unit volume and per unit weight of the working fluid.

Consideration of the producer efficiency opens such a wide field as to be beyond the scope of this paper.

As the cost of the energy is only a part of the proportionate cost of power, the importance of the efficiency varies with the proportion which this part of the cost bears to the total cost. It thus depends upon numerous considerations: the size of plant, load-factor, etc. In general, high engine efficiency increases in importance with increasing size of plant, and with increasing load-factor, and in such plants becomes the most important factor. In small plants with a poor load factor it may drop into secondary rank, compared with the fixed cost A, and the cost of maintenance and repair, especially if in the design of the plant the mistake is made of giving too much attention to high efficiency, and thereby too little to reliability and low maintenance.

2. *Space economy.* This factor depends essentially on the engineering skill and judgment in the design of the plant, and on the type of the prime mover. It affects the fixed cost of power, and varies greatly in importance, for instance, space economy in the huge plants of our large cities is of very great importance, while for smaller country plants, or plants in locations where unlimited space is available, it becomes of very little importance.

3. *Investment economy.* This depends largely on the available market, and the desired quality of the power. It affects the choice of the prime mover, for with an assured market, requiring a high grade of service, the large investment of a first-class modern plant with the best type of prime movers and ample reserve is most economical. In many of the earlier railway plants the conditions were such that single cylinder, non-condensing engines of the cheapest type gave the most economical and occasionally the only feasible arrangement. But even in the large first-class plants, in those parts of the plant that are only occasionally called upon for service, that is, which have a very low load factor, good judgment may suggest a cheaper and correspondingly less efficient type of apparatus than would be economical in the engines which are continuously in service. Such reserve and emergency plant thus offers a means of utilizing machinery which in the main plant has finished its useful life. To some extent this applies to the thermodynamic reserve of a water power plant, especially where it is only rarely called into service, and economy in first cost and in space and simplicity may outweigh high efficiency.

4. *Labor economy as determined by the amount and character of attendance required.* With a high price and poor quality of skilled labor, prime movers which require a higher grade of attendance become less economical than less efficient prime movers which can be operated by unskilled labor, or require only very little of skilled labor, and especially in our country, the reduction of the amount of high-grade skilled labor is economically necessary. It is this feature which has forced the designers of prime movers and electrical apparatus to devote their attention chiefly to make the apparatus as "fool-proof" as possible, even if efficiency and other characteristics have to be sacrificed to some extent. This fact has to a considerable extent determined the trend of development of the industry, so that types of apparatus which have proved entirely satisfactory in other countries were a failure here, until they had been re-designed to meet the requirements of being operated by the available class of labor. A characteristic instance of the effect of price and character of labor is the general introduction of the enclosed arc lamp in this country, while abroad the open arc is universally used. There the enclosed arc has never been accepted, due to its lower efficiency. As a result, the experience gained abroad with different types of prime movers and other apparatus is not directly applicable in our country, and conversly.

5. *Maintenance, repair, and depreciation.* This depends largely upon the type of prime mover, and in thermodynamic engines on the cycle used in the engine. Higher temperature differences, greater cylinder volume and piston pressure, heavier moving (especially reciprocating) masses, higher speeds (especially of reciprocating masses); in short, greater mechanical and temperature stresses in general, other things being equal, tend to greater maintenance and repair cost and more rapid depreciation. Thus this item is to some extent proportional to the mechanical efficiency, and inversely proportional to the thermodynamic efficiency of the engine cycle.

The economic item of depreciation depends, however, not only on the wear of the apparatus, but also on the limitation of its useful life. In this respect it must also be kept in view that with apparatus which is in a state of rapid development, as the steam turbine or the gas engine, the useful life should be expected to be shorter than with apparatus in a field in which no great development occurs. With a rapid advance in the development the time soon arrives where older apparatus is so far left behind as to make it more economical to replace it. This has been well illustrated by the history of the electrical industry. It would be an argument against the use of newer types of apparatus, and thus antagonistic to progress, if it were not for the fact that in the types of apparatus with which the new development competes the useful life is shortened in the same or probably still a greater degree, as either an extra rapid advance in their design must occur to meet the competition, or they would be replaced by newer types. Thus the useful life of the steam turbine, due to its rapid advance, must necessarily be shorter than the life of the steam engine would be if there were no turbine or gas engine; but due to the existence of steam turbines and gas engines, the useful life of the steam engine, as limited by the advance of the art, is correspondingly shortened, as it faces displacement by turbine or gas engine or also has to advance more rapidly.

It will be seen, therefore, that in the economic characteristics of thermodynamic prime movers in general, efficiency and the other features are to some extent mutually conflicting. Engineering judgment must therefore decide on the relative weights of the different economic factors which enter the choice of the prime mover in the individual case under consideration.

B. Reliability.

Features, which are of importance for the reliability; that is, continuity of service, are:

1. The absence or presence of external influences beyond the control of the operating force, as meteorological effects, etc.

2. The design of the plant. This is an engineering problem outside of the scope of this paper. It is obvious, however, that an error in the design can rarely be remedied afterwards; therefore, before the plant is constructed and before the buildings are designed, the arrangement of prime movers and electrical apparatus should be designed to afford the greatest safety of

operation. Frequently this has not been done. The architect of the buildings has overlooked the fact that the switch-boards and controlling devices of our modern large, high-voltage electric plants require considerable space, and such apparatus—on which the safety of the system depends—has been crowded together in an altogether insufficient space, to the great detriment of the reliability of operation of the system. A marked improvement has taken place in this direction in the last years.

3. The probable frequency of shut down of the prime mover, and the liability of involving other machines by it, and the number of other units and reserve plant available. To some extent this depends on the mechanical and temperature stresses in the prime mover; it is related to the economic item of maintenance, repair, and depreciation.

4. Rapidity of starting of apparatus, and getting them into service, to cope with emergencies as a shut down of the system or a part of it, as a break down of a transmission line or feeder, an accident to one or several units, etc., or even an unexpectedly rapid increase of load, and rapidity of reaction to changes of load; that is, speed regulation and voltage regulation, etc. These are important features in their effect on the reliability of service. They depend to a considerable extent on the type of prime movers and other apparatus, but to a still greater extent on the preparedness for such emergencies, and the organization of the operating force for it.

PRELIMINARY CENSUS REPORT ON TELEGRAPHS.

The statistics relate to the years ending December 31, 1907 and 1902. The totals include reports of commercial land telegraph companies owned and operated within the United States, and of domestic ocean cable companies operating from the United States, but do not include telegraph lines operated by railway companies.

	1907.	1902.	Per cent of increase.
Number of systems or companies	25	25	0.0
Miles of single wire (exclusive of ocean cable)	1,577,961	1,318,350	19.7
Nautical miles of ocean cables	46,301	16,677	177.7
Messages, total number	103,794,076	91,655,287	13.2
Total income	$51,583,868	$10,930,038	26.0
Total expenses (including taxes, interest and fixed charges)	$11,879,613	$30,918,034	35.3
Total cost of construction and equipment (including real estate)	$210,015,959	$161,679,579	29.9
Capitalization:			
Capital stock authorized, par value	$16,603,906	$123,233,075	31.1
Capital stock outstanding, par value	$155,089,575	$117,053,525	32.5
Dividends on stock	$7,477,083	$6,256,693	19.5
Bonds authorized, par value	$83,004,000	$49,893,000	66.4
Bonds outstanding, par value	$65,204,000	$45,893,000	42.1
Interest on bonds	$2,651,511	$1,949,150	36.0
Total par value stock and bonds outstanding	$220,293,575	$162,946,525	35.2
Employees and wages:			
Average number	28,031	27,627	1.5
Total salaries and wages	$17,808,249	$15,039,673	18.4

The final report for 1907 will contain an analysis of the above totals and present detail statistics for other phases of the industry.

Standard specifications for coal are being investigated by a committee of the American Society for Testing Materials. Dr. J. A. Holmes, of the U. S. Geological Survey, Washington, D. C., is chairman of the committee and B. F. Bush, president Davis Coal and Coke Company, Baltimore, Md., secretary. A classification of the users of coal who can properly purchase under standard specifications includes, (1) Steam plants; stationery, power, locomotives, ships, naval, etc. (2) Producer gas. (3) Domestic coal; low-pressure heating plants, anthracite, bituminous and coke. (4) Metallurgical: coke, smithing. (5) Gas (illuminating). (6) Cement and miscellaneous drying operations. Sub committees have been appointed to consider specifications for each of these classifications and report to the general committee next June, when the society holds its annual meeting at Atlantic City.

REGULATION OF GAS SERVICE.

In the course of a report on the question of suitable regulation of gas service for Chicago, submitted to the Committee on Gas, Oil and Electric Light, William B. Jackson finds several factors that must be given careful consideration in the formulating of rules for the regulation of gas supply, and each of these is considered under a seperate heading in the following:

The Heating Value of Gas.

From fifty to ninety per cent of the gas burned in the larger American cities is used in such manner that the heating quality of the gas is the active agency. This proportion includes gas burned for cooking and commercial heating purposes, and also gas used in illuminating devices where the light emanates from an incandescent element or mantle such as is found in the ordinary Welsbach burner. From this it will be seen that the question of calorific or heating power of the gas must be a highly important factor in determining the value of gas for use in heating and lighting.

By reference to the data already referred to and from a general study of the subject, it will be found that a mantle burner (wherein the heating power of the gas is made direct use of) will give from three to five times the amount of illumination per cubic foot of gas that is usually obtained from an open flame burner wherein the illuminating or photometric value of the gas is the active agency; and consequently, under most conditions where gas is used for long time burning or where there is any great amount of illumination required, the open flame burner should be displaced by the mantle burner. The advantages to be gained by the use of incandescent mantle burners wherein the heating quality of the gas is of paramount importance is not now fully recognized, but as the economy in gas consumption of the incandescent mantle becomes more universally appreciated and the cost of the mantle becomes less, the tendency will be for the value of the gas used for illuminating purposes to become more and more dependent upon its heating power. Four of the cities and states whose code of rules are included in the tabulations heretofore referred to, now make heating power an important test of the value of gas.

Illuminating Value of Gas.

In the code of rules for gas supply recently promulgated by the commission having such matters in charge in the State of Wisconsin, illuminating power of the gas is not prescribed for the present, while the heating power has been given prominence. We believe that the heating power should be given an important place in the rules in order that the best results from the gas service may be obtained in Chicago, but we do not believe that the illuminating value should be ignored. Many consumers of gas regularly use some type of open flame burner, and convenience dictates such use in many instances. And we therefore feel that the question of photometric or illuminating value of the gas should not be lost sight of in a code of rules for Chicago.

Impurities in Gas.

It is important that gas should be free from certain impurities, and should at no time have an excess of other impurities. Owing to the poisonous nature and extremely unpleasant odor of hydrogen sulphide, never more than a trace of this compound should be present in the gas; also the presence of sulphur in any other compound should be limited by the rules, and the same may be said of ammonia. There is some question regarding the amount of either sulphur or ammonia that should be allowed in gas, though the limits seem to be pretty well determined by existing practice.

Fluctuations in Pressure of the Gas.

It is impracticable to design a system for the distribution of gas wherein the pressure will remain constant at all periods of the day and night, and the question of the fluctuation that may be practically allowable is difficult of solution.

For any fixed adjustment of a gas burner the rate of consumption of gas varies with the pressure and there is one rate of consumption at which the gas is used most economically. Therefore the interests of most satisfactory service require that the

variations of pressure be kept as small as practicable. On the other hand, it is probably equally true that maintaining the gas supply over a great gas distribution system such as is found in the City of Chicago, allowing only small fluctuations of pressure, is one of the difficult problems a gas company has to face.

Some cities require that the fluctuation in gas pressure shall not exceed a definite amount at the inlet of the consumer's meter. Such a requirement appears to us to be unwise. It is possible to arrange a gas burner for economical operation when the supply pressure at the meter inlet is high and equally possible to arrange it for economical operation when the supply pressure is low (provided it is not too low). This may be accomplished by means of the burner cock or by the introduction at the burner of an orifice or check of the proper size to permit the appropriate amount of gas to flow to the tip of the burner or to be distributed to the incandescent mantle. In other words, the flow of gas to the burner must be the same whether the pressure is great or small at the meter inlet, to obtain economical results. But the flow of gas through a burner of fixed adjustment is dependent on the supply pressure,and the deviation from the best economy is therefore dependent on the percentage fluctuations of pressure of the gas supply. It is therefore apparent that the allowable fluctuations should be fixed on the basis of a percentage of the lowest pressure ever reached at each point considered. The lowest pressure here referred to must not be confused with the minimum allowable pressure on the system. This plan is followed in the code of rules for gas regulation recently promulgated by the commission in the State of Wisconsin, in which code a daily variation of 100 per cent of pressure at any point is allowed above the lowest pressure reached at the point.

From the above considerations it will be appreciated that a stable pressure is of much importance in the production of satisfactory gas supply.

Minimum Allowable Pressure.

The matter of allowable fluctuations in pressure being suitably dealt with, it is necessary to consider what the minimum allowable pressure may be. To afford satisfaction, it is essential that enough gas pressure shall be provided at the burners to send forth sufficient gas for the proper operation of the burners. If the pressure drops too low for any given type of burner, it is impossible to adjust the burner to give economical results. It is, therefore, important that a definite minimum shall be fixed below which the gas pressure shall not be allowed to go.

Maximum Allowable Pressure.

We are of the opinion that the question of the maximum pressure reached by the gas supply is not a very important one. There appears to be serious question whether, in the present state of the art, any maximum gas pressure should be fixed. There is no greater difficulty in obtaining good results from a properly constructed burner when the pressure at the meter is high than when the pressure is low.

However, many gas consuming devices require a very low gas pressure at the burner outlet to give most economical results, such pressure ranging from a fraction of an inch to two and one-half inches of water pressure, according to the burner (one inch of water pressure being less than four-hundredths of a pound per square inch). Also, most gas consuming devices are manufactured with the expectation of quite a low pressure at the meter inlets, so that some consumers will find it difficult to obtain satisfactory service from their burners with high pressures at the meter inlets unless necessary provisions are made for throttling the gas before it reaches the burner. Under these circumstances, it would seem that the Gas Company should be required to provide consumers now equipped with such burners with satisfactory service by adjusting their burners, and where necessary, provide the requisite checks at the burners to suitably reduce the pressure.

Location of Testing Stations.

We are informed that the gas company supplying gas service to the City of Chicago owns seven operating gas plants to provide gas consumed in the city. Three of these plants are located in the northeastern portion of the city and at a maximum of a mile and a quarter apart, and a minimum of three-quarters of a mile apart. Three of them are located in the eastern-central portion of the city at a maximum of a mile and a quarter apart and a minimum of about one-half mile apart, while the seventh is located in the far southeastern portion of the city, approximately nine miles from the nearest of the other stations.

The plans of the piping show all of the gas plants inter-connected upon the gas distribution system of the company, and some of them are so inter-connected that it would be substantially impossible to locate a testing station so that it would be sure to receive gas coming from only one of the plants unless the testing station was located immediately adjacent to the gas plant. This condition is exaggerated by the location of the gas storage reservoirs at different points in the city. It, therefore, seems that gas testing stations should not be located with sole reference to individual gas plants, but should be so placed that the gas received at each of the testing stations would be a fair average of the gas distributed in the district in which the individual station is located. That is, the effort should be made to test the gas in districts, rather than as it is supplied by the individual gas plants. Even with the most judicious locations of the gas testing stations, it is desirable that the tests made at such stations should be supplemented by testing samples obtained at different other points in the district in which the station is located.

It would seem that seven stations would satisfactorily cover the territory included in the gas distribution system in the city if the work at these stations is supplemented by samples as heretofore described.

Equipment, Size and Cost of Stations.

To make these testing stations most suitable for the purpose in hand, it would be desirable that each testing station should be equipped with a standard calorimeter for determining the heating value of the gas together with the necessary supplementary apparatus; with a standard photometer, having the necessary standard meters and standards of illumination for providing facilities for exact measurement of the illuminating value of the gas; with the necessary standard apparatus for determining the amount of hydrogen sulphide, sulphur and ammonia in the gas; with a recording pressure gauge, and "U" tubes for measuring the pressure of the gas, and miscellaneous equipment; and with at least three recording pressure gauges, by means of which the pressure of the gas may be determined continuously,—the recording meters to be placed at different points on the gas supply system outside of the testing stations, and their locations change from time to time. And for use in connection with all of the stations at least two gas analysis apparatus for complete analysis of the gas should be provided so that from time to time samples of gas could be fully analyzed.

Each station can be suitably housed in a room not larger than 14x18 feet, and the cost of the equipment of each station complete connected ready for operation should not amount to over $1,500.00.

Labor Required in Operating Stations.

Not over four men giving their entire time and attention to efficiently operating the seven stations as above enumerated including attention to the recording pressure gauges and to making tests of gas from various points on the gas supply system, should be able to obtain tests that would provide ample knowledge of the characteristics of the gas supply, such as would be necessary in determining whether every part of the city receives gas of suitable quality and pressure for satisfactory service.

In the above we have set forth the general conditions affecting the subject of the gas regulations with the object of pointing out the requirements that must be met to provide satisfactory gas supply, and in the following we give what we believe would be fair rules for gas regulation from the standpoint of the consumer of gas and from the standpoint of the company furnishing the gas.

Impurities.

Hydrogen Sulphide; Not more than a trace should at any time be found in the gas.

Total Sulphur; The amount of total sulphur should always be kept below a definite limit. Present practice indicates that the maximum allowable total sulphur should not be greater than thirty grains per one hundred cubic feet of gas, and we believe that for the conditions in the City of Chicago, twenty grains of sulphur per one hundred cubic feet of gas should be the maximum limit.

Ammonia; The amount of ammonia in the gas should also be kept below a definite limit. Present practice indicates that this limit should not be greater than ten grains of ammonia per one hundred cubic feet of gas, and we believe that ten grains per one hundred cubic feet would be a suitable limit for Chicago.

Illuminating Value of Gas.

We believe that the illuminating value of the gas in Chicago should at no time fall below twenty-two candle power when burned at the rate of five cubic feet of gas per hour as provided in the existing Chicago ordinance.

Heating Value of Gas.

We believe that the heating value of the gas in Chicago should not be permitted to fall below 600 British Thermal Units gross per cubic foot of gas.

All results given above are to be understood as applying to standard conditions of temperature and atmospheric pressure, namely 60 degrees Fahrenheit and thirty inches barometric pressure.

Pressure Fluctuations.

We believe that the maximum allowable variation of pressure at the inlet of any meter in Chicago should not be greater than 100 per cent of the minimum pressure found at any time at that meter, except that it should be one duty of the chief gas inspector to set a new minimum limit upon the written request of the gas company when the conditions affecting the minimum pressure change owing to the growth of the gas system or to development of the art; such changes to be made not oftener than once in six months. We understand that it is impossible at the present time for the gas company to maintain the gas pressure within such limits at all points upon their gas supply system. It would, therefore, seem that regulations relating to this feature of gas supply cannot be effective until the requisite changes have been made in the gas distribution system. In the meantime, we believe that the company should, upon the complaint of any consumer, at whose meter there is a greater variation than 100 per cent of the minimum pressure, adjust his gas consuming devices so that the gas service is satisfactory to him, or should provide a local governor to hold the variation in pressure at the meter within the above prescribed limits.

Minimum Pressure.

The allowable pressure at the inlets of consumers' meters should never become less than a definite amount. Present practice indicates that one and one-half inches of water pressure, at the street level, is a satisfactory minimum limit, and we believe that such a minimum would be a suitable one for the City of Chicago.

Maximum Pressure.

Our study of the question of gas pressures leads us to the belief that it is not desirable at the present time to set any hard and fast maximum allowable pressure in Chicago; but, owing to certain conditions heretofore explained, we believe where consumers now have gas consuming devices installed that will not suitably operate with pressures of over six inches at the inlet of the meter (located at the street level) that the gas company should adjust the consuming devices so that they will operate satisfactorily when the pressure rises above six inches.

Tests for Pressure.

We believe that in addition to the pressure measuring devices in the testing stations there should be at least three seven-day recording pressure gauges for each testing district to be located at various points over the district in which a testing plant is situated and the locations to be changed from time to time. Such testing gauges to be of the line drawing kind which show the pressure of gas at every instant and each chart to be arranged to show the pressure continuously for seven days.

Tests for Thermal Value and Candle Power.

We believe that besides the tests to be regularly made in the testing stations for heating power, additional tests should be made from time to time of gas taken at various points in each of the districts, and occasionally tests for candle power should be made as well as for heating power.

Complete Analyses of Gas.

From time to time complete analyses of the gas should be made in each testing station, and whenever tests for calorific value of gas are made at points outside of the stations complete analyses of the gas found at these points should be made.

Frequency of Tests.

We believe that tests for the candle power, thermal value, and the presence of hydrogen sulphide, in the gas, should be made daily, excepting Sunday, in each testing station, and the tests for ammonia and sulphur should be made weekly, while the recording charts of the various continuous pressure gauges should be changed weekly. The additional tests for thermal value and candle power of gas taken from outside points should be made from time to time as may be found necessary for a complete determination of the quality of gas as supplied throughout the city. Also the complete analyses of the gas should be made with sufficient frequency to properly supplement the other tests.

Rules as above proposed, if carried out by the gas company, will in our opinion, assure a satisfactory gas supply to the City of Chicago, and the operation of the testing stations and other supervisions outlined, when the work is carried out in the above described manner, will give the city all information needed for enforcing the rules.

Natural gas says Consul-General William H. Michael of Calcutta, issues from a crevice in the ground 20 miles from Chittagong. It has been burning so long that the oldest inhabitant can give no idea of when or how it was set on fire. The general belief among the natives is that the gas has been on fire for centuries. It is now suggested—and some steps have been taken to carry out the suggestion—that the fire be extinguished and the gas be brought under control and piped down to Chittagong for lighting and fuel and power purposes. The citizens of Chittagong have concluded that it would be cheaper to utilize the gas than to introduce electricity for fuel, power and lighting.

The Department of Electricity, San Francisco, is housed in a two-story brick building at 55 Fulton street. In the repair shop are built repeaters, tapper and alarm switches, telegraph keys for the switchboards, and other pieces required to keep the fire alarm system in repair and perfect working condition. The central fire alarm station is furnished with the latest appliances and is better equipped than ever before. The "Joker Signal" system, which was placed in operation for the first time in this city last October, has proved of great advantage, as it affords a quick method of giving information to the fire department of the movements of all fire companies. These reports are transmitted in the same manner as fire alarms. Another important addition to the fire alarm system has been the installation of a private exchange telephone system, which connects all of the fire houses with the central alarm station, thus giving the fire department independent control of all department telephones.

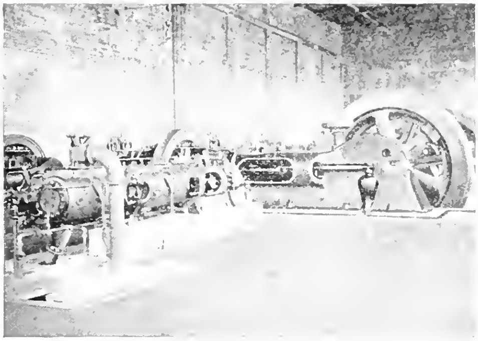
THE ECONOMY OF ELECTRIC DRIVE AS APPLIED TO BRICK AND TILE PRODUCTION.[1]

[illegible]

The question of the advisability of electric drive in brick and tile factories may at the present be regarded as decided in the affirmative. There are a great many points that affect the character of power distribution, and in addition to the saving in cost of supplying power to the productive machinery, all these other factors should be given due consideration. The satisfactory and economical handling of raw and finished material, reliability of service and the preventing of injury to individuals must also be looked out for. Future expansions of the plant should be made possible without undue rearranging the original equipment.

The electrical distribution of power so fully meets the requirements of brick factories that it has become recognized as pre-eminent for use in large as well as in smaller plants.

In making a choice between the various means for power distribution, a manufacturer should naturally bear in mind the effect that the various arrangements may have on the several elements that enter into the manufacturing cost. Manufacturing requirements demand the earning of dividends and this in turn necessitates that the product shall be turned out at the least total cost.

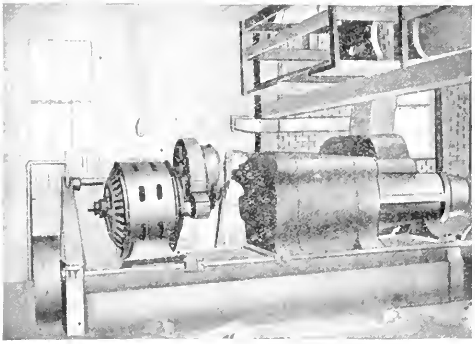


Power Plant of Columbus & Hocking Clay Construction Company at Kachelmocker, Ohio.

A mechanical system of driving is, besides inefficient, also inelastic. As machines are added time and again, the shafting, bearings and hangers become so strained and twisted that it is a wonder that they do not break down altogether. Our electric system, on the other hand, is perfectly elastic. Motors can be added from time to time without in any way affecting the efficiency of the system. Machines can be put in positions, which would be impossible if they were driven by means of belting, and besides this, a perfect control of the individual machine is made possible with the electric system.

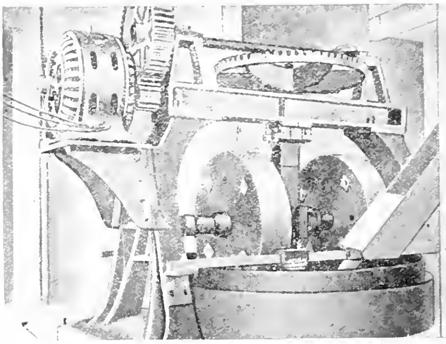
The fact, however, must never be overlooked that the generation of electricity by steam power must necessarily be dearer at the generator than the steam power itself. It is in the method of transmission and application that electricity scores and by [illegible] the motors right near the productive machines, [illegible] all unnecessary losses, can we secure the highest econ[illegible] [illegible] commercially [illegible] other method of driving. [illegible] of the power generating and distributing sys[illegible] [illegible] with other factors, [illegible] in regard to the efficiency of [illegible] in the distributing system naturally [illegible] and the value of this lost power is an item of great importance. With mechanical drive, these losses are constant as long as the shafting is running whether the productive machinery is running or not. This, is, however, not the case with electric drive as at no load when the motors are not running there is no loss taking place in the system.

An accurate knowledge of the absolute loss of power in driving shafts and belts would be of great value in determining the exact gain that would be affected if electric drive was substituted for mechanical drive. There has, however, been many tests made to determine these losses and it has been shown with



Induction Motor Driving Dry Pan.

the plant running *at full load* it will range from 30 to 60 per cent., an average for clay working plants being 40%. Should only a few machines be running the losses may of course come up to 75 or 80% of the generated power or in other words, four fifths of the coal consumption is wasted in friction losses. With the electric drive the losses are easily determined and will not exceed 25% of which 12% is consumed in the motors, 5% in the wiring and 8% in the generators. With the electric system it is possible to insert indicating instruments in the various circuits and a complete check can at all times be had on the power consumed by the various machines. This is particularly valuable in testing departments in order to determine the power required for driving brick machinery for different sorts of clay.



Induction Motor Driving Brick Machine.

The advantage of electric drive is especially apparent where the conditions demand the location of the powerhouse at a distance from the manufacturing buildings. Also when cheap electric power can be purchased from an electric power company, the value of electric drive is still further accentuated. In such case the power is supplied over long distance transmission lines

[1] [illegible] the [illegible] Association, Macon [illegible] 1909.

at a high voltage, which is stepped down at the manufacturing centre to a pressure adopted for the motors.

The alternating current three phase system is probably the best adapted for brick factories. This system consists of a three phase generator composed of a stationary and a revolving part, an exciter for delivering the magnetizing current for the generator fields, a system of distributing wires and motors.

The alternating current system is simpler than the direct current system in that no current has to be delivered to the rotating armatures of the motors through carbon brushes and a commutator. This commutator is the main difference between alternating and direct current motors. The brushes and the commutators are the only parts of the direct current motors in which trouble is liable to arise due to accumulation of dust and dirt. The simplicity, durability and freedom from break-downs, are therefore, the main advantages of the alternating current motor. The pressure best suitable is 220 volts as the danger by coming in contact with the wires is not very great and as this pressure can directly be used for the lighting system, which in all cases naturally is provided. Where very large motors are used, it may be advisable to use a pressure of 440 or 550 volts as with this voltage the size of the wiring can be considerably reduced. Step-down transformers for the lighting system will, of course, have to be provided in such a case.

The frequency of the system is usually 60 cycle as the same gives good lighting results, at the same time not causing any excessive inductive effects. The three phase system has the advantage over the two phase in that the wiring is simpler and in that the amount of copper required for the distributing system is less.

For driving brick machinery, where a high starting torque is required, the induction motors with phase-wound secondaries will exactly meet the conditions. The secondary winding itself has a very low resistance, which means high efficiency and good regulation. By the insertion of external resistance in the secondary winding the motor will be able to develop maximum torque of at least two times the normal running torque. Each motor should be provided with its own starter complete with overload and no voltage features. The former device will disconnect the motor on heavy overloads and the latter will disconnect the motor if the plant for some reason is shut down.

The operation of every machine and conveyor by its own motor produces a very satisfactory appearance but it may not return the most economical result. Very small motors are not so efficient as larger ones and besides they are more expensive per unit of power. For this reason it will frequently be found advisable to drive a group of smaller machines with one motor of a large capacity providing that the shafting for these machines does not become too extensive.

An example showing the actual saving of an electrically driven plant as compared to a mechanically driven one may prove of interest. Through the courtesy of the American Clay Machinery Company of Bucyrus, which company has installed several very successful electric driven plants, I have been fortunate to obtain data that will give a very accurate idea of the saving that can be accomplished.

Assume a brick plant with a yearly production of 25,000,000 bricks, which has to be equipped with the following productive machines:

1 Brick Machine, consuming	75 h. p.
1 Pug Mill	50 h. p.
3 Dry Pans, each	35 h. p.
Represses and Cutters	35 h. p.
Elevators	20 h. p.
Conveyors	8 h. p.
1 Exhaust Fan	50 h. p.
1 Disc Fan	10 h. p.

This will total approximately 350 h. p., the fans running 24 hours, but all of the other machinery only 10 hours per day.

Steam Driven Plant With Shafting.

The average load during the period when the plant is running will be approximately 85%.

Cost of Installation.

1 600 h. p. Boiler Equipment, complete with stack, pumps, piping, etc.	$ 9,000 00
1 400 h. p. Engine	4,500 00
1 60 h. p. Engine	2,200 00
1 15 h. p. Engine	600 00
Belting, Shafting, complete	2,500 00
Total cost of installation	$18,800 00

Horse power hours produced per year:

400 h. p., 85%, 10 hours, 300 days= 400x85x10x300=1,020,000

75 h. p., 85%, 24 hours, 300 days,= 75x85x24x300= 460,800

1,480,800

Cost of Production.

Fuel eight pound per h. p. hour= 5900 tons at $2.00=	$11,800.00
Interest, depreciation, taxes, insurance, etc., on Boilers and Engines, 15%, on $16,300	2,445 00
Interest, depreciation, taxes, insurance, etc., on Shafting and Belting, 30%, on $2,500	750 00
Oil, Waste etc.	750 00
1 Day Engineer at $75.00	900 00
1 Day Fireman at $60.00	720 00
1 Night Engineer at $60.00	720 00
Total cost of operation	$18,085 00

Steam Driven Plant With Electric Motors.

The average load in this case is only 80%.

Cost of Installation.

1 500 h. p. Boiler Equipment, complete with stack, pumps piping, etc	$ 7,000 00
1 350 h. p. Engine	4,000 00
1 75 h. p. Engine	2 200 00
1 250 K. W., 3 phase Generator	2,800 00
1 50 K. W., 3 phase Generator	1,050 00
Cabling	750 00
1 75 h. p. Motor for Brick Machine	675 00
1 50 h. p. Motor for Pug Mill	475 00
3 35 h. p. Motor for Dry Pans	1,050 00
1 35 h. p. Motor for Cutters and Represses	350 00
1 20 h. p. Motor for Elevators	300 00
1 8 h. p. Motor for Conveyors	115 00
1 10 h. p. Motor for Disc Fan	145 00
1 50 h. p. Motor for Exhaust Fan with Variable Speed Regulator	550 00
	$21,460 00
Less extra cost for Buildings	2,500 00
Total cost of installation	$18,960 00

Horse power hours produced:

350 h. p., 80%, 10 hours, 300 days= 350x80x10x300=840,000

75 h. p., 80%, 24 hours, 300 days= 75x80x24x300=432,000

Cost of Production.

Fuel seven pounds coal per h. p. hour = 4450 tons at $2.00 =	$ 8,900 00
Interest, depreciation, taxes insurance, etc., 15%, on $18,960 00	$2,845.00
Oil, Waste, etc	500 00
1 Day Engineer at $75 00	900 00
1 Day Fireman at $60.00	720 00
1 Night Engineer at $60.00	720 00
Total Cost of Operation	$14,585 00
Cost with Mechanical Drive	$18,083 00
Cost with Electrical Drive	14,585 00
Saving with Electricity	$ 3,500 00 =19½%

For gas driven plants the respective costs will be somewhat less than with steam driven

Assume the same plant as before but with gas engine, we get:

Mechanically Driven Plant.

Cost of Installation.

Producer Equipment	$11,000 00
Gas Engine	22,000 00
Belting and Shafting	2,500 00
Total	$35,500 00

Cost of Production.

Fuel, 1½ pounds of coal per h. p.=1010 tons at $2.50	$2,525 00
Interest, Depreciation, Taxes, etc	5,500 00
Oil, Waste etc	500 00
1 Day Engineer at $75 00	900 00
1 Helper at $40 00	480 00
1 Night Engineer at $75 00	900 00
Total	$11,005 00

Electrically Driven Plant.

Cost of Installation.

Producer Equipment	$9,000 00
Gas Engines	18,000 00
Generators	3,850 00
Cabling	750 00
Motors	3,660 00
	$35,260 00
Less Extra Cost for Building	2,500 00
Total	$32,760 00

Cost of Production.

Fuel $1\frac{1}{2}$ pounds per h. p. hour=950 tons at $2.50	$2,275 00
Interest, depreciation, taxes, etc.	1,920 00
Oil, Waste, etc.	300 00
1 Day Engineer at $75.00	900 00
1 Helper at $40.00	480 00
1 Night Engineer at $75.00	900 00
Total	$9,775 00
Cost with Mechanical Drive	11,005 00
Cost with Electric Drive	9,775.00
Saving by Electricity	$ 1,230 00 =11 per cent.

Another place where a considerable saving can be made is by adopting electricity for the hauling of the clay from the clay banks to the factory. In one case in a brick plant outside of Chicago where this system has been installed, the operating force alone for this part of the plant was reduced by about ten men.

That there is a very large field open for the introduction of electric drive in existing brick plants and the tremendous saving that thus could be accomplished is shown by the government's statistics:

Number of plants	4,634
Number of plants reporting	5,476
Number of steam engines	4,113
Total horsepower	246,200
Number of Gas Engines	220
Total horsepower	6,245
Number of Electric Motors	128
Total horsepower	3,036

Before concluding this paper it would be well to consider what one of our prominent brick machine manufacturers has to say in regard to the electric drive:

"Try to picture in your mind a brick plant free from line shafting and the necessary millwright work to support it, or the necessary brick or concrete piers. No line shaft bearings to require proper oiling. No pulleys. No couplings to work loose. No belting to fan the air, break or get loose and slip. No constant renewals and sewing of same. No danger of employees being maimed by being caught in belts, and such accidents, to be followed up by annoying and expensive law suits, and payment of lawyers' fees, court cost and damages. And when the "electric juice" is taken from a centralized plant or trolley line there will be no boilers, no engines, no engineer, no fireman, no water, no coal, no smoke, soot, ashes or dust. With the machinery properly built, setting on good foundations, driven by direct connected motors, a greater portion of the noise is removed. Then imagine a dryer drying your brick with waste heat drawn from kilns being burned with producer or natural gas, thus eliminating smoked-up brick in the dryer, no coal laying around the kilns, no men to handle the coal and ashes from the kiln, no smoke rolling from the kilns. This is not a dream, but the future brick maker's millenium, which a great many are enjoying to-day."

SOUTHERN PACIFIC RECONSTRUCTION IN ALAMEDA.

During the past week three electrical engineers from the Southern Pacific Company, Messrs. Moulthrop, Cahey and Clapp, made a trip of inspection over the local lines of the corporation to plan for the installation of the electric traction system that is to supplant the company's steam roads in Alameda. The experts were accompanied on their round of inspection by City Electrician Joseph B. Kahn, Street Superintendent V. M. Frodden and Harry Brownlee, local superintendent of the Pacific Telephone and Telegraph Company.

It was found that but few changes will be necessary in the location and position of the city's wires. The Southern Pacific Company plans to place ornamental steel trolley poles in the center of the avenues and streets through which its electric trains will run.

According to Mayor E. K. Taylor the Southern Pacific Company will put men to work on converting its local steam roads into electric lines as soon as the right of way for the connecting loop around the east end has been obtained.

SONS OF JOVE REJUVENATE IN SAN FRANCISCO.

THE Rejuvenated Sons of Jove had a very successful Rejuvenation on the evening of February 13th at the Hotel Argonaut, San Francisco, at which seven penitents with regrets for their past life, were initiated, cleansed of their sins and became members of the rejuvenated order.

These penitents who are now wiser and better men, are as follows:

Lorrin Andrews Nott, San Francisco.
Albert Casper, Vallejo, Cal.
Albert Wilkinson Vinson, San Francisco.
Lester Siebenhauer, San Francisco.
Casper Vincent Schneider, Sacramento.
Charles Lewis Turner, San Francisco.
Edwin Boaz Pike, San Francisco.

The Rejuvenation was a very interesting and dramatic one and was followed by a German supper at which forty-six members were seated. Speeches were tabooed and the amusement was furnished by the Knickerbocker Quartette, who furnished an excellent program, including the most recent popular songs.

The National organization of the Sons of Jove includes a membership of about 2,000 of which 100 are in California. Great interest is being taken in the order and the membership is increasing steadily. It is expected that another Rejuvenation will be held within the next three months, when it is hoped to add to the interest of the ceremony by the use of scenery and electrical effects.

POWER FROM COKE OVEN GAS.

While the adoption of gas engines operating on by-product coke oven gas is becoming active in this country, Japanese industries are also recognizing its advantages. The Furukawa Coke Works, Japan, recently ordered through Takata & Co. (Japanese agents for Westinghouse interests) an extension to their present gas engine plant which has been in service for some time at the coke works. The equipment ordered is a Westinghouse vertical single-acting gas engine. This order, although not of large size, illustrates the recognition of the advantages of the gas power system and illustrates dependence which the Japanese people place in American-made machinery. A similar equipment has been ordered by the Imperial Printing Office of the Japanese government, although not to operate on coke oven gas.

Engines of the same size and type have been in operation for several years in the United States at the works of the Semet-Solvay Co., Syracuse, N. Y., and at the Otto Coke Works, Camden, N. J. The most important application of by-product coke oven gas has occurred at Lebanon, Pa., where there are now located two plants aggregating several thousand horsepower. Both of these employ the Westinghouse horizontal double-acting type gas engine, solid couplet to alternating current generators for power, light and traction service. All of the equipments are of standard Westinghouse construction, and one of these plants which has been operating for over a year, has thoroughly proven its adaptability, without requiring special design. This plant regularly operates on run-of-oven gas ranging from 50 to 65 per cent hydrogen and one to two grains sulphur per cubic foot. This plant is located at the Lebanon works of the American Iron and Steel Manufacturing Co. The second plant under construction is located near Lebanon, at the works of the Cornwall Ore Banks, otherwise known as the Pennsylvania Steel Co., adjacent to the extensive plant of the Semet-Solway Co. Further important developments in this line are anticipated in the near future.

The electrification of the Melbourne tramways has been deferred by the Victorian Railway Commissioners after careful consideration of a report made by Mr. Charles Merz.

CURRENT COMMENT

Tantalum lamps, 220 volts, are now on the market.

Thomas A. Edison celebrated his 63rd birthday on February 11, 1909.

Electric transmission of photographs by the Korn apparatus is in commercial use between Paris and Berlin and London.

Electric power for the Alaska Treadwell mines is to be supplied by a $750,000 hydro electric plant to be built on the Taku run, thirty miles from Juneau, Alaska.

Electrification of the Salt Lake and Ogden Railway is to be accomplished by equipping the present steam road with over-head trolley and high-speed interurban cars.

A bursting fly wheel wrecked one of the buildings at the Anaconda smelter in Montana last week. Fragments of iron were hurled through the roof of the building but no one was hurt.

Electric snow mel.ers are being used to clear the streets of Berlin, Germany. With an experimental apparatus the cost proved to be less than half that of shoveling and carting it away.

Weather reports by wireless telegraph are furnished the British Meteorolgical Offices by ships in the Atlantic. The ocean has been divided into numbered areas so as to locate all reports.

California's oil production for 1908 is estimated at from 44,000,000 to 46,000,000 barrels of crude petroleum, exceeding that of 1907 by about twelve per cent, when California was second in rank among oil producing states.

Water for copper smelting at Ely, Nevada, is brought to the Steptoe Valley plant, from Duck Creek by a 32-inch pipe line, 48,000 feet long, delivering 1,200 cubic feet per minute. A 250 h. p. electric generator is to be operated by waste water from the pipe line.

Electrification of Japanese railroads is recommended in an exhaustive report submitted by the Imperial Engineer Corps, Tokio being the first center of attack. Japan has large water powers that will readily lend themselves to hydro-electric power developers.

The largest storage battery in the world is to be installed at the Sixteenth Street substation of the New York Edison Company by the Electric Storage Battery Company. It will have 150 cells wi.h a capacity of 22,000 amperes for one hour at 120 volts. It is to be used for emergency needs.

A British Radium Institute is to be established by the King of England to apply radium in research and medical work. Austria has forbidden the export of radium from Bohemia, Europe's chief source, and a company has been formed to manufacture it from pitchblende found in the mines of Cornwall.

Examination for mechanical and electrical engineer will be held by the United States Civil Service Commission on March 17-18, 1909, to fill a vacancy in the position of mechanical and electrical engineer, $1,200 per annum, Quartermaster's Department at Large, Fort Bayard, New Mexico, and vacancies requiring similar qualifications as they may occur in any branch of the service. The examination will consist of mathematics and practical calculations (comprising arithmetic, algebra to and including problems involving quadratics, geometry, mensuration, logarithms and use of tables, elementary problems in mechanics, use of slide rule, interpretation of formulas and the correct working out of results for special cases); drawing, involving a competent knowledge of machine construction and ability to draw neatly to scale; materials, comprising all the materials employed in machine construction; theory and practice of electrical engineering, comprising theory, nomenclature, practical computations, and construction and operation of simple machines and apparatus (competitor will be given a choice of questions in this subject); training and experience (rated on application). Applicants who fail to indicate in their applications that they have had at least five years' practical experience in mechanical and electrical engineering will not be admitted to this examination. Graduation in mechanical or electrical engineering will be considered as equivalent to not less than three years of this period.

American Society of Hungarian Engineers and Architects has been organized by a number of Hungarian engineers and architects pursuing their professions in this country. The society has two objects: First—to bring in closer touch engineers and architects of Hungarian extraction, living in this country, and to give moral support and information to newcomers. Second—to encourage the exchange of engineering, technical and industrial information between the technical men of Hungary and of the United States and to foster technical societies, sciences and industries. The society will hold monthly meetings where papers will be read and discussed. The membership consists of mechanical, electrical and civil engineers, chemists, architects and draftsmen. Following are the officers of the new society: President, A. Henry Pikler, M. E., engineer in charge of transformer department of Crocker-Wheeler Company, Ampere, N. J.; Vice-President, Karoly Z. Horvay, architect, chief draftsman, Building Bureau of Board of Education, Brooklyn, N. Y.; Secretary, Zoltan de Nemeth, M. E., New York Edison Company; Treasurer, Sandor Oesterreicher, E. E., New York Edison Company; Assistant Secretary, Ernest L. Mandel., B. S. C. E., Bureau of Commissioner of Public Works, New York City. The society's business address is Box No. 103, New York City.

A telegraph between England and India has been completed, making direct communication between London and Calcutta. According to the Electrical Review, the Indo-European Telegraph Company's line from London passes to Lowestoft, then by submarine cable to Germany, through Emden and Berlin to Russia, through Warsaw, Rowno, and Odessa to Kertch, where the company has three submarine cables across the straits; thence it passes through Tiflis and Tabriz to Teheran, the capital of Persia, which, until January 20th, 1909, was the terminus of the Indo Company's circuit. In December, 1902, the construction of a new line from Teheran to Kurrachee was taken in hand, and has been completed, making the terminus of the Indo Company's line on Indian territory. The new line increases the total length of circuit from 3,800 miles to 5,374 miles. This extension of 1,574 miles has entailed the provision of three additional repeater stations, one at Teheran, another at Kerman, and the third at Panjur in Beluchistan. All messages between England and India passing over this route will be received direct without re-transmission, there being now thirteen automatic repeaters in the circuit. As an illustration of what could be done when required, various line extensions were added to the circuit by other automatic repeaters, and direct communication was thus obtained at a speed of about 40 words per minute with Madras, and later with Calcutta and Rangoon, a distance of 7,700 miles, the record.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electrical Casualties

When we handle electricity carelessly we run the risk of fire or death. Before such an event happens it is usually called a hazard, afterwards, an accident. This trait of courting the possibility of loss or harm for the possibility of benefit is even older than the derivation of the word hazard. Four thousand years ago the ancient Persians "played craps" with "el zar." In the seventh century of the present era the Arabs forced their language and customs on the people of Spain and the Spaniards thus call any unexpected happening "azar," which the French have converted into "hazard." Like the game from which it derives its name, in a hazard the possibilities of gain or loss are nearly equal.

This is hardly true of electrical construction, for the advantages of electricity are far greater than any possible damage which may result from its use, especially when such damage may be avoided by proper precautions. In so much as the results of this carelessness in the handling of electricity at high potential can be anticipated, any disastrous consequences should be called a causuality rather than an accident, which is incalculable.

But enough of this pedantic quibbling over words. This matter is a serious question requiring public attention The insurance companies, through the Underwriters' National Electric Association, have prescribed rules and regulations minimizing fire from electrical causes. These rules are enforced by exacting the penalty of higher insurance rate. Such mildness unfortunately does not characterize the penalty for violation of the rule not to come in contact with current carrying devices.

Analyzing a discussion of this question which has recently appeared in "Electrocraft," we find three factors that contribute to the life hazard of electricity. First, there are certain dangerous fixtures, which are under the ban of the Code, and are fast being eliminated. Second, there is the matter of the proper grounding of transformer secondaries and exposed conductors. Lastly, there is the voltage limit allowable in places ordinarily reached by the public. While this is an economic question in the distribution of power and light, it is one that should be investigated.

With regard to the responsibility for the safeguarding of the public, "what is everybody's business seems to be no one's business." In shifting this burden the secretary of the Underwriters' National Electrical Association makes the apt comparison of an automobile, whose gasoline is subject to regulation on account of the fire insurance, but whose speed limit is purely a life hazard, and therefore beyond his domain. Reasonable requirements can be enforced by state or municipal authorities, and it is probably to them that we must look for relief.

PERSONALS.

G. B. Rice has been appointed chief draftsman for the Pacific Electric Railway at Los Angeles, Cal.

T. E. Bibbins, of the General Electric Company, left on Tuesday for a trip of a week or ten days to Sacramento and Salt Lake City.

Emerson W. Read announces the removal of his law offices to the Thomas Clunie Building, California and Montgomery streets, San Francisco.

Mr. D. D. Schindler, 439 Thirty-seventh street, Oakland, Cal., has been appointed representative of the Anderson Porcelain Company of East Liverpool, Ohio, for San Francisco and vicinity.

C. F. Brady, formerly purchasing agent of the Pacific Electric Railway Company at Los Angeles, now represents a number of well-known Eastern manufacturers in Los Angeles with an office at 641 Pacific Electric Building.

C. W. Scott, manager of the San Francisco office of the H. W. Johns-Manville Company, has returned from an Eastern trip during which he visited several of their Eastern houses, and attended the conference of managers which was held in New York.

E. K. Patton, western manager with headquarters at Chicago, for the Bryant Electric Company, and the Perkins Electric Switch Manufacturing Company, of Bridgeport, Conn., will reach San Francisco on his annual Pacific Coast trip on February 20th.

PROGRAMME ELECTRIC VEHICLE CONVENTION.

St. Francis Hotel, San Francisco.

FRIDAY, FEBRUARY 19TH.

10:30 A. M.—Welcome to Delegates and Opening Address
R. B. DAGGETT.
Manager San Francisco Office Electric Storage Battery Company.

11:00 A. M.—"The Mercury Arc Rectifier."
R. M. ALVORD,
General Electric Company, San Francisco.

1:00 P. M.—"Vehicle Batteries."
GEORGE R. MURPHY,
Engineer Electric Storage Battery Company

3:30 P. M.—"Relation of Central Station Companies to the Automobile Business."
MR. FRED T. KITT,
Sacramento.

5:00 P. M.—"The Electric Vehicle Motor."
J. T. DEREMER,
Westinghouse Electric and Manufacturing Company, San Francisco.

SATURDAY FEBRUARY 20TH.

9.00 A. M.—"The Commercial Electric Vehicle."
A. C. DOWNING,
Manager Electric Automobile Department, Studebaker Brothers Company, Pacific Coast.

10.30 A. M.—"Electric Pleasure Vehicles."
F. W. PFAFFMANN,
Los, Angeles,
Representing Rauch & Lang of Cleveland.

11:30 A. M.—"The Electric Garage."
S. P. REED,
Reed Electric Laboratory, San Jose, Cal.

Discussions will follow all papers and a general discussion will follow the presentation of the last paper on Saturday.

SAN FRANCISCO SECTION A. I. E. E.

A meeting of the San Francisco Section of the American Institute of Electrical Engineers will be held on Friday, February 26, 1909, at 8 p. m. Mr. S. B. McLenagan, general manager of the Central California Traction Company, of Stockton, will read a paper descriptive of their new 1,200 volt direct current road, the only one in the world employing such a high line voltage.

WESTINGHOUSE PATENT LITIGATION.

The Westinghouse Electric and Manufacturing Company recently brought suit against the Bullock Electric Manufacturing Company for infringement of the Tesla polyphase system and of the Nolan Spring Ring Armature. With regard to the former Judge Thomsen of the United States Circuit Court for the Southern District of Ohio, has decided that infringement exists, but with regard to the latter has decided that there is no proof of infringement.

In the Edgewise Circuit Breaker case brought by the Westinghouse Electric and Manufacturing Company against the Condit Electrical Manufacturing Company, the United States Circuit Court of Appeals upholds the validity of the Wright and Aalborg improvement in automatic circuit breakers and sustains the claim of infringement.

LOS ANGELES SECTION A. I. E. E.

Los Angeles Section of the American Institute of Electrical Engineers met at the University of Southern California on Tuesday, February 16, 1909, at 8 p. m. A paper on "Limitations in Hydro-Electric Transmission," was read by R. I. C. Wood.

TRADE NOTES.

The Marshall Electric Company, manufacturers of the well known Marshall line of Sockets, Switches, Pipe Ends and other specialties have moved from their former location in Boston to Hyde Park, Mass., where they will occupy a new and modern factory building constructed especially for them.

The Standard Electrical Construction Company have closed a contract for the electrical work in the new Thompson Cafe, which will be opened between the first and fifteenth of the coming April, in the basement of the Flood Building, which was occupied by Tait's restaurant prior to the San Francisco fire.

B. C. Van Emon, of the Van Emon Elevator Company, who has just returned from a trip through the Northwest, advises that while he was in Vancouver, B. C., he was successful in closing a contract with the Dominion Trust Company for the entire electrical elevator equipment in the new Imperial Hotel there. The amount of the contract is in the neighborhood of $25,000. He also closed, while in Vancouver, a contract for one passenger and two freight elevators in a business block now under construction there.

TRADE CATALOGUES.

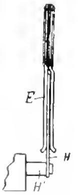
Instruction Pamphlet No. T5042, from the Westinghouse Traction Brake Co., shows the construction and gives directions for regulation and adjustment and installation and maintenance of electric pump governors for the automatic control of motor-driven air compressors.

The new bulletin on Alternating Current Switch Boards recently issued by the F. Bissell Company, of Toledo, Ohio, is devoted to single, two and three phase demands in generator, feeder and totalizing panels, as well as D. C. Exciter Panels. This, together with information covering instruments, switchboard parts and appliances, as well as line drawings of all standard boards and photographs of notable installations makes it of value to the electrical trade.

The Garvin Machine Company, Spring and Varick streets, New York City, are distributing their edition "D" catalogue. This catalogue is printed in English, German and French, and illustrates and describes their line of Profiling Machines, both Wesson and belt-driven, No. 14 and No. 15 Vertical Spindle milling machines, No. 2 Lincoln milling machine; five sizes of Duplex milling machines; No. 3 Universal cutter and tool grinder; tapping machines, including horizontal, vertical and automatic; gang drill presses and duplex drill lathes.

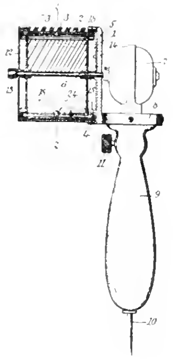
PATENTS

911,439. Contact Plug for Electric Irons, Heating Appliances, and the Like. Richard G. Pheysey, Ontario, Cal. In combination, an insulating plug having recesses and holes formed therein and also slots leading from said recesses, two spring clips each formed of two members of sheet metal



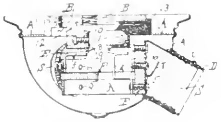
secured together so as to inclose one end of the lead wires, said clips being secured within the holes formed in the plug and extending into the recesses therein, and two tongues or binding posts secured to the terminals of an iron and adapted to project into the plug and between the spring members of each of the clips, as specified.

911,472. Electric Safety Razor. Luigi Brunacci, New York, N. Y. A safety razor having a handle, a bracket attached to the end of said handle and having an offset upwardly projecting head, an electric motor seated on said bracket and



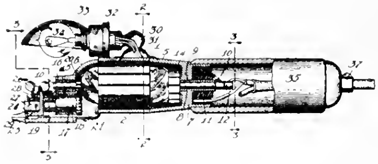
having a shaft extending through said head, a substantially cylindrical guard attached to the outer side of said head, and a rotary blade holder attached to said shaft within said guard.

911,475. Multiple Lamp Socket. Leger J. Castonguay, Bridgeport, Conn., assignor to The Bryant Electric Company, Bridgeport, Conn. A multiple socket cluster having a series



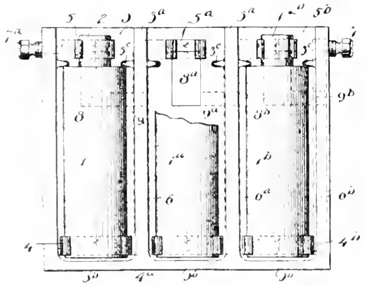
of socket units, each unit with its axis inclined but with its mounting base piece parallel to the axis of the cluster for the purpose described.

911,139. Electrically-Actuated Hair and Wool Clipper. Hugo Luense, Chicago, Ill. In a device of the character described, the combination of upper and lower motor pole plates, cores extending between said pole plates at each end thereof, field windings surrounding said cores and openly exposed as to their outer sides, an armature interposed between said windings and pole plates, a hollow frame member rigidly secured to the rear edges of the pole plates, an armature shaft journal opening in said frame member receiving the shaft of said armature, commutator brushes yieldingly mounted to extend longitudinally within said frame member and bearing yieldingly against the commutator of the armature, a tubular handle rigidly connected with the rear end of



said frame member, a second hollow frame member rigidly connected with the front edges of said pole plates, an armature shaft journal opening in the latter frame member, a counter shaft bearing formed to extend through the front end of the latter frame member, intermeshing gears upon the armature shaft and counter shaft, respectively, a fixed shear blade rigid with said second hollow frame member, a reciprocatory shear blade movably mounted upon said fixed blade, and driving connections between the counter shaft and movable blade.

911,522. Electric Battery Holder and Battery. George L. Patterson, New York, N. Y. In apparatus of the character described, a holder, devices carried thereby arranged to make electrical and mechanical connection with a plurality of batteries, said devices including two sets of terminals, both



terminals of one set being electrically connected with one of the terminals of a second set when no battery is in engagement with the first-mentioned set, and a circuit closer in the first-mentioned set adapted to be operated by a lateral movement of the battery when the latter is inserted in or removed from the holder.

911,055. Mounting for Fuses. John J. Lyng, New York, N. Y., assignor to Western Electric Company, Chicago, Ill.

A fuse-mounting comprising a tube of refractory insulating material, a metal cap molded upon the end of said tube, said head having a screw embedded therein, with the shank of said screw projecting through said head to receive a binding nut, in combination with a fuse wire contained within said tube and having its end embedded in the material of said molded head and thus electrically connected to said screw.

INDUSTRIAL

A NEW LINE OF ALTERNATING CURRENT SELF-STARTERS.

A new line of self-starters designed for use with alternating current motors has recently been placed on the market by The Cutler-Hammer Manufacturing Company, of Milwaukee. These include self-starters for use with single, two or three phase motors which may be thrown directly across the line to start two types of self-starters for squirrel cage motors and two for slip ring motors. In addition to these five types of self-starters the same company has brought out a line of two-pole and three-pole float switches.

The float switch is used in connection with a copper float, chain and weight for automatically starting and stopping motors, operating pumps on open tank systems. By adjusting two buttons on the chain passing through an eye in the arm of the float switch, this arm will be moved up or down whenever the water in the tank reaches a predetermined high or low level, thus opening or closing the circuit to the solenoid of the self-starter which in turn operates to stop or start the motor.

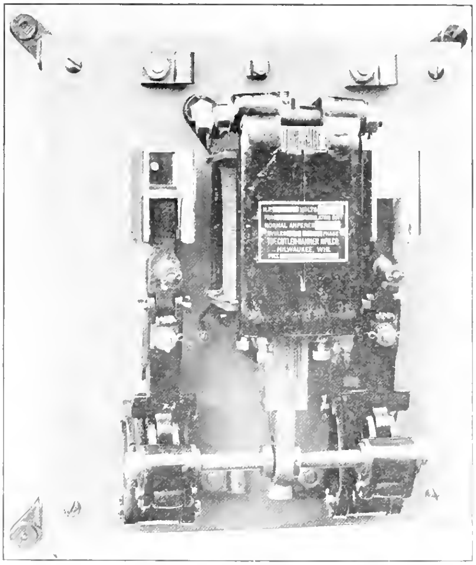


Fig. 1. Cutler-Hammer Self-Starter for 2 or 3 Phase Motors.

The self starter, illustrated in Fig. 1, standard in sizes from 1 to 15 h. p., but can be used only with single, two or three phase motors which can be thrown directly across the line to start. It can be used in connection with a float switch and copper float on open tank systems and by substituting a pressure regulator for the float switch it can also be employed for automatically starting and stopping motors operating on compression systems.

It finds a further application in the vacuum air cleaning systems which are now being so widely installed in hotels, apartment houses and office buildings. In such cases, the motor, self starter and vacuum pump are usually installed in the basement and a snap switch or push button for starting and stopping the motor is placed on each floor, or in each room, if desired, these being connected to the solenoid of the self-starter by small pilot wires, the heavy wiring being again reduced to a minimum as in the case of self-starters used in connection with pumps.

The self-starter shown in Fig. 2 reduces the starting current by inserting resistance in the primary circuit of the motor. Where it is desirable to still further reduce the starting current, a potential type of self-starter should be used. Squirrel cage motors are not well adapted for starting under heavy loads, hence the self-starters above described should be used only where the starting duty is light. They are well adapted for starting line shafts, ventilating fans or centrifugal pumps, but are not suitable for use with reciprocating pumps or machinery starting under load.

As stated above, the self-starter illustrated in Fig. 1, can be used only in connection with alternating current motors which can be thrown directly across the line to start. The leading power stations of the country limit the size of the squirrel cage motors which they will permit to be thrown directly across the line to 5 to $7\frac{1}{2}$ h. p. If larger motors are installed it is necessary to reduce the starting current taken by the motor so as to avoid causing violent line disturbances. In such cases the self-starter illustrated in Fig. 2 should be used.

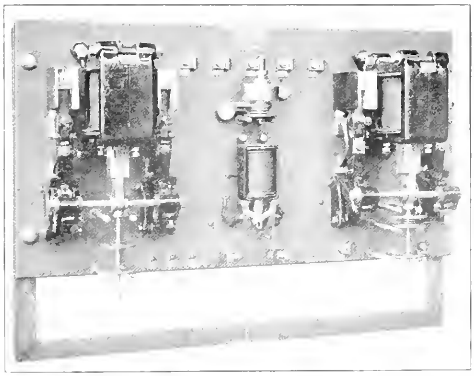


Fig. 2. Cutler-Hammer Self-Starter for Squirrel-Cage Motors.

The slip ring type of motor is much better suited for heavy starting duty than the squirrel cage motor, its starting characteristics being similar to that of a direct current shunt wound motor in cases where the starting torque does not exceed 250 per cent of the normal torque. In other words, a line current of 150 per cent gives a starting torque of 150 per cent which is usually sufficient to start an average load. Where it is desirable, therefore, to reduce the starting current taken by the motor to the lowest possible amount a slip ring type of motor should be used.

THE WESTINGHOUSE-LEBLANC CONDENSER.

The American adaptation of the type of condenser which has been so favorably received in Europe, is meeting with success in this country. A number of contracts have been closed during the summer for equipments, most of which are in connection with new turbine equipment.

The Narragansett Electric Light Company, Providence, R. I., is installing two units, 7000 h. p., in connection with new turbine equipment.

The B. F. Goodrich Rubber Company, Akron, Ohio, have ordered one unit in connection with a new turbine for their central power plant. This company was among the pioneers in the use of the Westinghouse turbine, and heretofore most of their experience has been with the surface type condenser.

The Coronet Phosphate Company, Plant City, Fla., have

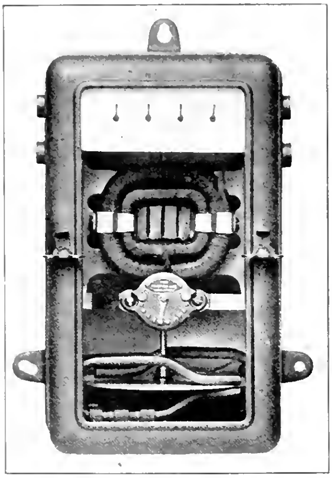
ordered three units for use also in connection with turbines, and the Portland Cement Company, Trinidad, Colo., one unit. Likewise the City of Logansport, Ind., and the Bristol, Tenn., Gas and Electric Company.

Other equipments are being built for the Jersey Central Traction Company, the Washington and Mt. Vernon Railway, in connection with their new turbine plant, and the Cleveland Electric Company, which equipment is about to go in service.

The Westinghouse-Leblanc condenser possesses many advantages in the way of compactness, and particularly in the ability to maintain high vacuum with limited supply of cooling water. Upon repeated tests it has been able to operate within from one to five degrees difference between the temperature corresponding to the exhaust steam and that of the cooling water discharge. This represents an efficiency of the condenser of 96 to 99%. These results are obtained by an unusually efficient method of handling the entrained air and are particularly effective in cases of high cooling water temperature, 80 to 85 degrees. They also greatly favor the employment of cooling towers in connection with the condensing plant, reducing the quantity of water to be pumped and increasing the effectiveness of the cooling tower surface by delivering water to the tower at the highest possible temperature.

NEW DUNCAN METERS.

A new Duncan Direct Current Integrating Wattmeter, house type, model E, is now being put on the market by the Duncan Electric Manufacturing Company. The accompanying illustration, from which it will be seen that its design is very much up to date and in strict accordance with modern requirements.



Duncan Direct Current Integrating Wattmeter.

The back portion, as well as the lower shelf or magnet support, are made from sheet brass formed up into shape under enormous pressure, so that they present a degree of strength and rigidity that surpasses the castings used on the older forms, besides reducing the total weight of the meter. Mounted upon the lower magnet support or shelf is a well proportioned [illegible] which is also pressed up from sheet brass, and to which [illegible] attached the series field coils, compensating coil, upper [illegible] bearings and compensating switch, thereby enabling all [illegible] elements to be combined on one support.

The [illegible] binding posts are so constructed and fastened into [illegible] of the meter that they are not only dust proof but abso[illegible] proof. The registering train has four circles of large dimensions, so that they can be read with much ease at a considerable distance. The gear wheels and pinions are cut by automatic machinery, which renders the possiblity of their binding or sticking very remote.

The multipoint switch method of compensating for friction and vibration is maintained throughout the entire line of these instruments, and no change has been made in it by virtue of its giving such universal satisfaction, and which all meter experts pronounce as being the most reliable that has yet been used. To secure any degree of compensation simply involves the movements of the compensating switch lever over one or more contacts, and when the proper amount has been obtained, it is impossible to bring about any change through rough handling, as is usually the case where such compensation is secured through bodily adjustment of the compensating coil.

The cover is dust, moisture and insect proof and is held in position in a new and novel manner by the use of wing headed screws which are so fastened upon the inside that it is impossible for them to drop out and become lost when the cover is turned upside down. This feature will be appreciated by linemen who have always objected to the old method of fastening the covers, by having to come down off the ladder to look for a screw or wing nut which they dropped.

The method of sealing is also new, and is an absolute guarantee against tampering by unauthorized individuals.

The accuracy of this new instrument surpasses anything now on the market, and is due to its very high turning moment, the smallest size having a torque of not less than 200 milimeter grams, or nearly 25% greater than any other now in use. The larger meters have, of course, a greater torque and in some of these sizes it is as high as 600 millimeter grams.

The quality of the steel employed to make the permanent magnets is the same as has been used by this company for years, and is known as the "Remy brand." It is a special steel of exceptionally high retentivity and permanence and is recognized as being superior to all others for these two qualifications. In order to make these magnets as permanent as possible, they are put through a process of artificial aging which enables them to maintain a uniform strength for an indefinite period, so that the accuracy of the meter is never changed unless through some other cause, such as the accidental breaking of a sapphire jewel or the like.

For the 110 volt sizes, the resistance unit is of the cartridge type. It is 4 inches long and 1 inch in diameter, and is slipped into the meter in the same manner as you would a cartridge fuse into a fuse block, which renders its removal or insertion a matter of a few seconds and is a wonderful improvement over other methods and forms still employed. This resistance unit is imbedded within a fire proof composition, so that the matter of being troubled with burned out resistances is at an end as far as the new Duncan Meter is concerned.

The other patented features which have made the Duncan product so popular are still retained, such as the visual bearing, which permits the insertion and removal of the detachable spindle point also examining and oiling of the bearing; the threadless jewel post which has put an end to the threaded type that causes so much trouble by binding in the threads.

The old form of armature is also maintained, by virtue of its having proved itself to be much better than any that has yet been tried. It is very easy to repair; it is mounted upon a light framework; and is wound with 8000 turns of No. 40 B. & S. gauge electrolytic copper wire insulated with Italian Tram Silk.

The brushes are of the direct tension type which have demonstrated for themselves that it is the only safe and practical way to avoid sparking, particularly when the meter is installed in places where there is vibration.

To facilitate the work of testing, each meter is now marked with the exact number of watts that is required to make one revolution per minute, so that anyone undertaking to test the meter will know the watts required without having to figure it out from a constant.

The Duncan Company has also put upon the market a full

line of astatic switchboard meters. The series field coils are so arranged that they oppose each other, and within them is placed a four pole armature with the brushes set upon the commutator at an angle of 90°.

The tests which have been going on for some time have proven, beyond the possibility of a doubt, that this type overcomes to a great degree the influence of external fields. By bringing bus bars as close to the meter as its mechanism will permit the errors introduced thereby are scarcely perceptible and do not exceed 2%.

This new idea of the Duncan Company as applied to their meters is also being carried out in the larger sizes of their house type meters, inasmuch as there has been a complaint for years, from central stations regarding the detrimental influence which nearby conductors have on their accuracy.

A NEW IDEA IN DESK LAMPS.

Proper illumination of desks is a problem which has never been satisfactorily solved. Most of the lamps used for this purpose today consist of an ordinary incandescent bulb lamp placed in a small reflector, which throws nearly all of the light on one section of the desk and leaves the balance of the desk insufficiently lighted.

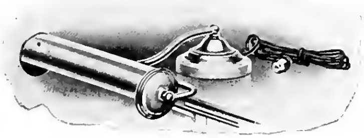


Fig. 1.

The nearest thing to perfection in this line is a new line of desk lamps recently placed on the market by the H. W. Johns-Manville Company, New York, known as "Linolite" Desk Lamps. Several of these are shown by illustrations herewith.

While the design of these lamps is somewhat different from others now on the market, their novel feature is in the lamp. Instead of the ordinary bulb lamp generally used, the tubular Linolite lamp, here shown, is employed.

Fig. 2.

This tubular Linolite lamp is 12 inches long between centers and, therefore, distributes the light more evenly and over a larger area of the desk than bulb lamps. Its filament is stretched out straight from end to end and lies throughout within the focus of the reflector. As the filament of a lamp throws its greatest light at right angles to its axis, this Linolite lamp naturally gives more useful light than bulb lamps, whose filament cannot lie in the focus of a reflector on account of being coiled. These lamps are made in burnished (old) brass finish, oxidized copper finish and gun metal finish, and present a very handsome appearance.

NEW DALE CLUSTER AND SHADE HOLDER.

Illustrated herewith is a new cluster and shade holder made by the Dale Company. It embodies several ingenious ideas, being made in two parts, the detachable base and the cluster body. A simple pull detaches and a push securely locks it; no twisting or turning, no chance for the cluster to unscrew from stem. All parts are completely insulated with the best quality porcelain; no fibre insulation used. Cluster can be used for either inside or outside work.

The body or shade may be readily removed without disturbing any wire connections. This cluster is made for from 2 to 7 lights.

One of the distinct advantages of the Dale new cluster is the fact that the detachable bases may be wired up and when the mechanics are out of the building the cluster body, shades, etc., may then be installed.

DALE DETACHABLE CLUSTER

TURBINE EXPERIENCE.

A 300 k. w. Westinghouse turbine unit has been in operation at the Burlington Municipal Electric Light plant, Burlington, Vt., since 1906. A recent report from this plant states officially that the total expense for repairs up to the present time, has been $1.83. Since its installation, this turbine has run nearly every night, and, it is stated, "has proven very economical in the consumption of steam, and the uniformity of speed is remarkably good. In fact, we do not know how it could be more satisfactory."

The first electric railway in Warsaw, Russia, was put in service in April, 1908, and will be managed by a syndicate which has a contract with the city until 1922. The company operates 304 cars and charges 3.6 cents for first-class passengers and 2.5 for second-class. The daily hours of labor for employees are from 7 a. m. to 11:30 p. m., for which motormen receive 62 cents to 67 cents and conductors are paid 62 cents to 83 cents.

SAN FRANCISCO, CAL.—The specifications for the 43,000 tons of cast iron pipe needed for the auxilliary fire protection system in this city were formally approved last week by the Board of Public Works, and bids called to be opened March 10 on the $1,200,000 job.

Compulsory wireless telegraph equipment on ocean going vessels as recommended by President Roosevelt in a recent message to Congress is provided in a bill just passed by the House of Representatives.

APPROVED ELECTRICAL DEVICES

ATTACHMENT PLUG, FUSELESS.

"G. E." Separable Cap types. 6 A. 125 V., 3 A. 250 V. Porcelain. Cat. No. 42456. Composition Edison type, Cat. No. 58729, 58730. Cord Connector type, Cat. No. 59071. Approved Jan. 20, 1909. Manufactured by

General Electric Co., Schenectady, N. Y.

CABINETS.

"Lang" Standard Metal Panelboard Cabinets and Sheet Steel Entrance Boxes. Approved Dec. 28, 1908. Manufactured by

Lang Electric Co., 116 N. Lincoln St., Chicago, Ill.

CONDUIT BOXES, FLOOR OUTLET.

"G. E.," "P. R.," "Adjustable" and "Adjustable self-leveling" types water-tight floor outlet boxes. Cat. Nos. 76470, 76459, 76460, 75940. Approved Jan. 18, 1909. Manufactured by

General Electric Co., Schenectady, N. Y.

CONDUIT OUTLET PLATES.

"Fancleve" cast iron outlet plates. Cat. Nos. 601 to 605 inclusive for knob and tube work. Cat. Nos. 700 and 701 for armored cable. Cat. Nos. 171 to 175 and 161 to 165 inclusive for use with canopies of fixtures where supply wires are in wooden moulding. Cat. Nos. 561 to 565 inclusive for use with rigid conduit. Approved Jan. 18, 1909. Manufactured by

J. L. Gleason, Jamaica Plain, Mass.

GROUND CLAMPS.

"Perma-Effect." A single strip of hard drawn copper, having the ends secured by a single bolt and provided with lug for soldered connection to ground wire. Size for ⅜ to 3 inch pipe. Approved Jan. 23, 1909. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

HEATERS.

"Pacific" Pressing Irons. Domestic patterns 3 to 12 lbs., for circuits of not over 250 volts. Irons equipped with approved plugs and cord. These irons have very heavy cast iron and pressed steel extensions at back, serving as stands when device is not in use. It should be noted that as yet no adequate means have been brought forward for eliminating certain hazards incident to the use of electric pressing irons and records show that such devices left with the current "on" are causing comparatively frequent losses. The general design and workmanship shown in the construction of these Pacific irons and accompanying stands were approved Dec. 28, 1908. Manufactured by

Pacific Electric Heating Co., Ontario, Cal.

RECEPTACLES, MINIATURE.

"G E." Miniature and Candelabra porcelain base receptacles, ½ A., 125 V. Cat. No. 9445, Miniature, cleat type. Cat. No. 9446, Candelebra, cleat type. Cat. No. 60103. Candelebra Sign receptacle. Approved Jan. 18, 1909. Manufactured by

General Electric Co., Schenectady, N. Y.

RECEPTACLES, STANDARD.

"Hubbell" Wall Sockets, pull type, 50 C. P. 250 volts, Cat. Nos. 35006, 35028, and angle base 35021. Also ceiling socket Cat. No. 35032. Approved Dec. 28, 1908. Manufactured by

Harvey Hubbell, Inc., 35-37 Organ St.,
Bridgeport, Conn.

RECEPTACLES, STANDARD.

"Tregoning" receptacles, 3 amp., 250 volts. Cleat type. Cat. No. 303, Sign. Cat. Nos. 300, 301 and 302. Approved Jan. 4, 1909. Manufactured by

Tregoning Electric Mfg. Co., 224 High St.,
Cleveland, Ohio.

ROSETTES, FUSELESS.

"C. E. M. Co." concealed type single piece rosette, 3 amp., 250 volts. Approved Dec. 28, 1908. Manufactured by

Conn. Electric Mfg. Co., Riverside Ave., Bantam, Conn.

SIGN-MACHINES.

"Carbon-Break" type, 15, 30, 45 and 60 amp. per switch for 110-220 and 220-440 volts circuits. "Series-Carbon" type, 500 to 200 amperes for 600 volt grounded circuits. Approved Jan. 30, 1909. Manufactured by

Reynolds Dull Flasher Co., 152 Fifth Ave.,
New York City, N. Y.

SIGN-MACHINES.

"Chaser," "Script" or "Lightning" type. Current rating 2 amperes per circuit; for 125 volts only. "Flag" type, current rating, 3 amperes per circuit, for 125-250 volts. Approved Jan. 29, 1909. Manufactured by

Reynolds Dull Flasher Co., 152 Fifth Ave.,
New York City, N. Y.

SOCKETS, STANDARD.

Brass shell sockets, key 50 c. p., 250 v., keyless 3 a., 250 v. Cat. Nos. 60504-7 and 60510-11 with mica disks under Edison screw shell. Approved Jan. 30, 1909. Manufactured by

Marshall Electric Co., Boston, Mass.

SOCKETS, WEATHERPROOF.

C. E. M. Co., all porcelain pendant type, 3 a., 250 v. Cat. No. 9306. Approved Jan. 15, 1909. Manufactured by

Connecticut Electric Mfg. Co., Bantam, Conn.

SWITCHES, SURFACE SNAP.

"G. E." with or without indicator, closed or slotted bases. Single pole, 3 a., 250 v.; 5 a., 125 v.; Cat. Nos. 59873-74, 60294-95. Single pole, 5 a., 250 v.; 10 a., 125 v.; Cat. Nos. 60447-50. Double pole, 5 a., 250 v.; 10 a., 250 v.; Cat. Nos. 60950-53. Three-way, 1 a., 250 v.; Cat. Nos. 60451-54, 60296. Three-way, 3 a., 250 v.; 10 a., 125 v.; Cat. No. 60955. Three-way, 5 a., 250 v.; 10 a., 125 v.; Cat. Nos. 60455-56. Four-way, 2 a., 250 v.; 5 a., 125 v.; Cat. Nos. 60458-59. Two-circuit, 2 a., 250 v.; 5 a., 125 v.; Cat. Nos. 60460-63. Three-circuit, 2 a., 250 v.; 5 a., 125 v.; Cat. Nos. 60464-67. Manufactured by General Electrical Co., Schenectady, N. Y.

SWITCHES, SURFACE SNAP.

"Perkins" three-pole snap switches with Vulcabeston commutators, 15 amp., 125-250 volts. Cat. Nos. 2025, 2026, 2045, 2046. Approved Dec. 23, 1908. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

TRANSFORMERS.

Bell Ringing Generator. A transformer with primary designed for connection to a 110 volt A. C. lighting circuit. Secondary coil with taps furnishing voltages of 6, 12 or 18 volts. Approved Jan. 18, 1909. Manufactured by

Connecticut Telephone & Electric Co., Meriden, Conn.

NEWS NOTES

FINANCIAL.

CHICO, CAL.—The report of the Chico Water Supply Company shows a profit of $2,000 last year on an investment of $155,456.

COLUSA, CAL.—The Colusa County Telephone Company has bought the system of the Pacific Telephone and Telegraph Company in Colusa county, the price paid being $15,000. The company now has entire control of the Colusa county lines and the long distance business will be handled over the Sunset lines, a royalty being paid for all long-distance switches. Work has commenced on the combining of the two lines and important improvements are being made.

EUREKA, Cal.—Superintendent M. M. Martin of the Humboldt Transit Company, has issued his semi-annual report of the receipts of the street railroad system for the six months ending last December. The total receipts for the last half year, are given as $42,660.50. The city's share, based on the ratio of 3½ per cent of the gross is $1,493. By months the receipts are given as follows: July, $7,909.90; August, $7,254.90; September, $7,369.30; October, $6,566.65; November, $6,385.25; December, $7,174.50. These figures show quite an increase over the receipts for the first six months of 1908, the receipts for that period being reported as $40,557.85, while a decided loss is shown as compared with the last six months of 1907, there being $45,152.85 taken in during those six months.

SANTA ROSA, CAL.—The Santa Rosa Water Company has issued a statement of receipts and expenses for the period since it began business. The revenues from all sources, for the year just closed, were $12,831.07, of which $12,262.52 was for water rents and $568.55 for service and connections. The net earnings for the year were $3,989.62, and the expenditures were divided as follows: Renewals, repairing and street work (including materials), $2,314.50; rents and miscellaneous office expenses, $905.74; sundries, $310.38. The gross receipts since the commencement of business to January 1, 1908, were $359,518.10. The construction account to January 1, 1908, totaled $186,602.75, and for the past year $210, which makes a grand total of $186,812.75.

OAKLAND, CAL.—President Louis Titus, of the People's Water Company announced in a statement last week that beginning with the new fiscal year the people of Oakland would be granted a reduction of five per cent in water rates. The lowering of the rates is part of an agreement of the water company to grant a yearly reduction until the rates reach the figures which prevailed during the Dornin Council, 29 per cent less than the rate of last year. Because the revenue derived from the city last year had fallen $30,000 short of the expected returns, the company could not see its way clear to grant a greater reduction [illegible] that to reach the Dornin rate will require an annual five per cent reduction for five years. The net revenue for the Oakland division during the year was $529,000. On this figure the rate charged was 16 cents per 1,000 gallons.

SAN FRANCISCO, CAL.—Manager E. C. Bradley, of the Pacific Telephone and Telegraph Company, has stated before the Board of Supervisors that the valuation of the company's plant is $7,218,269.82. This valuation includes a $450,000 franchise. The net earnings were $517,182.03, or a trifle over 8 per cent on the valuation excluding the franchise allowance. The company's business has increased at the rate of 1,000 new telephones a month, the total number of telephones now installed exceeding 47,000, but Mr. Bradley believes that when the Home Company begins service this rate of increase will be checked somewhat. Although the present rates are considerably lower than those which previously prevailed he states that the company will be satisfied with the continuance of the prevailing rates. It was also mentioned that about only half the public stations are profitable, the San Francisco office being credited with but 15 per cent of the long-distance business which emanates from this city. Mr. Bradley stated that similar conditions exist in Los Angeles and that during the past year the company had lost considerable money there.

INCORPORATIONS.

BAKERSFIELD, CAL.—The Coalinga-Kern Oil Company has been incorporated here with a capital stock of $100,000 by J. B. Wrenn, F. W. King and J. Robinson.

CENTRALIA, CAL.—The Twin City Light and Traction Company has been incorporated here with a capital stock of $400,000 by H. C. Coffman, T. Hoss and A. Welch.

FRESNO, CAL.—The Kerman Land and Water Company has been incorporated here with a capital of $25,000 by W. S. Brush, G. B. Ramm, S. T. Hall, G. E. and M. E. Hart.

BAKERSFIELD, CAL.—The East Coalinga Oil Company has been incorporated here by P. Rightetti, C. F. Reynolds, J. M. Ryme, John McMullen and J. H. Bernard.

SANTA ANA, CAL.—The Orange County Gas Company has been incorporated here with a capital stock of $200,000 by D. L. Peters, M. L. Bellus, J. W. Kemp, E. B. Rhoades and J. S. Mitchell.

LOS ANGELES, CAL.—The White Star Oil Company has been incorporated here with a capital stock of $100,000 by R. Arenz, W. W. Martin, W. H. Fuller, T. E. Shreiber, G. N. Fuller and others.

RENO, NEVADA.—The Postal Telegraph Cable Company has been incorporated here with a capital stock of $25,000, for the purpose of operating a line of magnetic telegraph through Nevada and other states. The incorporators are: W. P. S. Hawk, O. W. Bowers, and W. S. McCormick, of Salt Lake City.

TRANSMISSION.

REDMOND, OREGON.—It is reported that J. G. McGuffie will install a power plant at Cline Falls.

SONORA, CAL.—The Tuolumne Water Power Company has been granted the privilege of erecting transmission lines and maintaining electric light and power lines upon certain highways, until January 1, 1911.

SAN DIEGO, CAL.—P. F. Schaniel and A. N. Jones were granted a franchise by the Board of Supervisors to use the tide waters at the entrance to False Bay for the purpose of erecting a wave motor to generate electric power to supply the bay and surrounding settlements with electric lights and power.

OROVILLE, CAL.—Secretary H. P. Wilson, of the Great Western Power Company, announces that work will soon be commenced on the increasing of the present capacity of the electric plant at Big Bend, to 144,000 horse-power. Construction work will also begin this spring on the dam that will convert Big Meadows into a reservoir site of 20,000 acres, where water will be stored in the winter for use during the dry season. It is estimated that five million dollars will be spent on the new works. The company has been busy for the past week erecting temporary poles to take the place of the number of steel towers that were blown down by the recent storms.

NORTH YAKIMA, WASH.—R. B. Brown of Seattle, has appropriated 10,000 cubic feet per second of water from the Yakima river to be used for power purposes.

MEYERS FALLS, WASH.—The Northwestern Light and Power Company and the Spokane International railway expect to construct a power plant to cost $100,000.

PALOUSE, WASH.—The Idaho-Washington Light and Power Company of which M. J. Shields, of Moscow, is head, is said to have taken over the plant and business of the Palouse Light and Power Company.

PORTLAND, ORE.—An electric submarine cable carrying 10,000 volts is to be placed under the Columbia river to carry power for lighting and other purposes in Vancouver by the Portland Railway, Light and Power Company.

SANDPOINT, IDAHO.—The Pend d'Oreille Water and Light Company of this place have entered into a contract with the Humbird Lumber Company, through T. J. Humbird, the president, to furnish water and light for the new town of Kootenai, two miles north of Sandpoint.

PRESCOTT, ARIZ.—M. J. Hickey, Robert Brow and Henry T. Andrews have been granted a franchise by the City Council to erect and operate an electric lighting and power system. Steam, hot water and hot air heating, cold storage, telephone and telegraph systems will also be established.

BAKERSFIELD, CAL.—Contracts are being signed by West Side oil men for a year's supply of water at 4 cents a barrel with a new company promoted by R. E. McCauley, of Los Angeles. The company, which is said to be backed by English capital, proposes to build a pipe line from Ray's creek on Pine Mountain about forty miles south of Midway.

SALT LAKE CITY, UTAH.—The Utah Light and Railway Company is about to order a second 75-ton, 3,000 horsepower motor generator costing $35,000, the order being a duplicate of the machinery just installed by Minneapolis manufacturers. An emergency plant, costing half a million will be erected without delay at the Jordan River with a steam power equal to one-half the total demands made on the present plant.

TELEPHONE AND TELEGRAPH.

RAYMOND, WASH.—W. W. Cannon has been granted a telephone franchise. He will rebuild the local system.

MEDFORD, OREGON.—The Citizens' Telephone Company has asked for a franchise. Plans for a telephone building to cost $10,000 have been completed.

SONORA, CAL.—General Manager T. S. Thornton, of the Tuolumne Water Power Company has been awarded a franchise by the town trustees for a telephone line from the city limits through Barratta street, over Wolfling's property and across Leonard's hill.

SAN FRANCISCO, CAL.—The Oceanic Steamship Company has closed a contract with the United Wireless Telegraph Company for the installing of wireless plants on the steamers Mariposa and Alameda. The plants will be installed on the next arrival of the steamers in port.

MULLAN, IDAHO.—For the purpose of installing an up-to-date plant at Mullan and an exchange to take the place of the temporary exchange, and to extend the service of the company along various lines, it has been decided by the stockholders of the North Idaho Telephone Company to increase its capital stock from $25,000 to $100,000.

SAN RAFAEL, CAL.—Manager Fraquelin, of the Pacific Telephone and Telegraph Company states that $150,000 is to be spent in improving the local systems about San Rafael. Two-thirds of this amount is to be expended in improving the plants in Ross, San Anselmo and Kentfield. All the overhead wires are to be supplanted by a large cable. The monthly valley rate will be reduced at least 50 per cent.

ILLUMINATION.

NAPA, CAL.—H. D. N. Lehe has been granted a fifty year franchise by the supervisors of Napa county for a transmission system for transmitting electric light, heat and power.

LOS ANGELES, CAL.—The Anaheim Gas Company has practically completed arrangements for taking over the gas company of Orange. The works will probably be moved to Anaheim and the consumers of Orange will be served by pipe line from Anaheim.

LOS ANGELES, CAL.—J. R. Anderson & Company, of Pasadena, have been granted by the trustees a fifty year franchise for installing gas mains here. Work on laying pipe will begin about March 1st.

SAN FRANCISCO, CAL.—A warrant has been issued against the San Francisco Gas and Electric Company by the Fish Commission of this city charging the company with discharging refuse oil and coal tar products into the bay. Professor Frank T. Green, of the Affiliated Colleges, has been engaged to analyze the deposits and his reports are expected this week.

TRANSPORTATION.

LEWISTON, IDAHO.—M. A. Means has been granted a franchise for a street railway in Lewiston.

OLYMPIA, WASH.—C. T. Mork is endeavoring to get a franchise for an interurban line between Tacoma and Olympia.

LOS ANGELES, CAL.—W. F. Vollmer, has been awarded by the council a franchise for a street car line on Fifty-fourth street from Hoover street to Dalton avenue.

SNOHOMISH, WASH. — The Everett-Tacoma Railway Company has been formed with a capital stock of $2,500,000 to build an electric railway through Snohomish and Cherry valleys. G. M. Cochran of Snohomish is interested.

SAN FRANCISCO, CAL.—Chief Engineer B. P. Legare, of the United Railroads, in the absence of General Manager Black, asserted before the Board of Public Works this week that the company would expend $500,000 in track betterments during the spring, and during the next four years probably $5,000,000 would be spent. Just as soon as the weather settles work will begin on the completion of the Market street job. He promised that Twenty-ninth, Devisadero and McAllister streets would soon be given new road beds with heavy rails.

OIL.

LOS ANGELES, CAL.—The big well of the Pacific Petroleum Company at Beverly, owned by the West Coast Company, is drawing the attention of prominent oil men. The gusher is increasing its output and now, by calculations based upon measurements, it is producing an average of 1,200 barrels a day. There is not a piece of land to be had in the entire vicinity and property which a few weeks ago could be bought for $1,700, cannot now be bought for three times that sum. A rotary and bore is being erected on the southeast corner of the Consolidated Petroleum just north of this site, this being the first new work to get this vicinity under way.

REDONDO, CAL.—The Associated Oil Company, who established themeslves here last spring, are making plans which will undoubtedly make Redondo one of the largest distributing ports on the Pacific Coast. Seventeen agents, representing the company, are in foreign countries and it is understood that a contract has just been closed with a Tokio concern whereby a line of Japanese oil vessels will ply between the Orient and this port. Negotiations are also being made with a South American concern for the shipment of oil. This company is now shipping over over 60,000 barrels a month from this port to San Francisco.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer — who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

ADAPTERS

LAMP ADAPTERS

Benjamin Electric Mfg. Co.
Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.

ALARMS

BURGLAR ALARMS

Edwards & Co.
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc.
Western Electric Co.

FIRE ALARMS

Edwards & Co.
Western Electric Co.

WATER ALARMS

Partrick, Carter & Wilkins Co.

ANCHORS

Johns-Manville Co., H. W., "J. W."
Kierulff, B. F. Jr. & Co., "Hubbard."
Klein & Sons. Mathias.

ANNUNCIATORS

Edwards & Co.
Elec. Goods Mfg. Co., "Ross," "Rivol," "Perfect," "Nox-all."
Partrick, Carter & Wilkins Co., "King."
Standard Elec. Wks. "C.&S."
Stanley & Patterson, Inc.
Western Electric Co.

ARMS

CROSS ARMS

Kierulff B. F., Jr. & Co.
California Pole & Piling Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

MAST ARMS

Elec. Appliance Co., "Cutter"
Ft. Wayne Electric Works.
Kierulff, B. F., Jr. & Co., "Cutter"
Western Elec. Co., "Fletcher"

TELEPHONE TRANSMITTER ARMS

Dean Electric Co.
Elec. Appliance Co., "Eaco."
Kierulff, B. F., Jr. & Co., "Sterling."
Sterling Elec. Co.
Western Elec. Co

INDEX TO ADVERTISEMENTS

ASBESTOS

Johns-Manville Co., H. W.

BATTERIES

DRY BATTERIES

Dean Electric Co.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Stanley & Patterson, Inc., "Exeter." "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

DRY BATTERY HOLDERS

Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES

Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY

Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
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Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick, Carter & Wilkins Co.
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Western Electric Co., "Hawthorne."

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Edwards & Co.
Electric Goods Mfg. Co.
Marshall Elec. Co.
Partrick, Carter & Wilkins Co.

MAGNETO BELLS

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Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

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Henshaw-Bulkley & Co.
Keystone Boiler Wks., "Parker."
Moore & Co., Chas. C., "B. & W."
Standard Electrical Works, "Robb-Mumford."
Tracy Engineering Company, "Edge Moor."

BOOKS

Technical Book Shop.

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WALL BOXES

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Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knockout."
Chicago Fuse Wire & Mfg. Co., "Union."
Cole Co., John R., "Bossert."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
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Harvard Elec. Co.
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Electric Goods Mfg. Co., "Advance."
Edwards & Co.
Welsbach Company.
Western Electric Co., "Edwards."

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Belden Manufacturing Co.
Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
National Conduit & Cable Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
Standard Electrical Works, "Simplex."
Standard Underground Cable Co.
Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

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Nat'l. Conduit & Cable Co.
Western Electric Co.

TELEPHONE CABLE
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Reisinger, Hugo, "Electra," "Nuernberg"

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Western Elec. Co., "Thomas"

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Western Electric Co., "Deltabeston."
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Johns-Manville Co., H. W., "Magic."

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Cole Co., John R., "Circular Loom."
Sprague Electric Co., "Greenfield."

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Elec. Appliance Co., "Galvaduct," "Loricated."
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Cole Co., John R., "Electroduct."
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General Electric Co.
Kierulff, B. F. Jr. & Co., "National."
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Roebling Sons Co., John A.
Simplex Elec. Co.
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Okonite Co., The, "Okonite."
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General Electric Co., "G. E."
Standard Electrical Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

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Standard Elec. Wks., "M. A. Co."
Wagner Electric Mfg. Co.
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co.

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Standard Elec. Wks., "Jandus," "Century."

Vestern Elec. Co., "Victor," "Emerson."
Vestghse Elec. & Mfg. Co.

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Standard Elec. Wks., "Jandus."
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hase-Shawmut Co., "Shawmut."
hicago Fuse Wire Mfg. Co., "Union."
. & W. Fuse Co.
eneral Electric Co.
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hase-Shawmut Co., "Shawmut."
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arvard Electric Co.
ass & Seymour.
erson, Roeding & Co., "Aluminum."

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ryant Electric Co.
arvard Electric Co.
arshall Electric Co.
erkins Elec. Switch Mfg. Co.
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. & W. Fuse Co.
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tandard Elec. Wks., "Couch & Seeley."
Vestern Electric Co.

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WATER-WHEEL GOVERNORS

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General Electric Co.
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Welsbach Company.

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Vulcan Electric Heating Co., "Vulcan."
Westghse Elec. & Mfg. Co.

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STREET HOODS AND FIXTURES

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Ft. Wayne Elec. Works.
General Electric Co.
Kieruiff, B. F., Jr. & Co., "Cutter."
Western Elec. Co, "Fletcher"

INSULATORS

GLASS INSULATORS

Brookfield Glass Company, "Brookfield."
Elec. Appliance Co., "Hemingray."
Pierson Roeding & Company, "Locke Triple Petticoat."
Roeblings Sons Co., John A., "Knowles."
Western Elec. Co., "Brookfield."

HIGH-TENSION INSULATORS

Roeblings Sons Co., John A., "Lima."
Kieruiff, B. F., Jr. & Co., "Ohio Brass."
Pacific Elect'l Works, "New Lexington."
Pass & Seymour.
Pierson, Roeding & Company, "Locke."
Thomas & Sons Co., R.
Western Elec. Co., "Thomas"

PORCELAIN INSULATORS

General Electric Co.
Holabird-Reynolds Elec. Co., "Electric Porcelain."
Pass & Seymour.
Pierson, Roeding & Company, "Locke."
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Western Elec. Co., "Thomas"

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Holabird-Reynolds Elec. Co., "Sterling" Varnish.
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Kieruiff, B. F., Jr. & Co., "Di-electric."
Paraffine Paint Co., Agents "P. & B." Products.
Standard Underground Cable Co., "Ozite."

JOBBERS

Fobes Supply Co.

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t. Wayne Electric Works, "Wood."
ieneral Electric Co., "G. E."
tandard Electrical Works, "Jandus." "Boulevard."
Vestern Electric Co., "Hawthorne."
Vestghse Elec. & Mfg. Co.

FLAMING ARC LAMPS

ieneral Electric Co., "G. I."
Vestern Elec. Co., "Beck."
Vestghse Elec. & Mfg. Co.

GAS ARC LAMPS

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ryan-Marsh Co., "Imperial."
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olumbia Inc. Lamp Co., "Columbia."
lec. Appliance Co., "Packard."
airbanks, Morse & Company "Fairbanks-Morse."
eneral Elec. Co., "Edison," "Lowatt."
olabird-Reynolds Elec. Co., "Femco."
ierulff, B. F., Jr. & Co., "Excelsior."
Johns-Manville Co., H. W., "Linolite."
Pacific Electrical Wks., "Columbia."
Standard Electrical Works, "Improved California."
Sterling Elec. Co., "Sterling."
Sunbeam Inc., Lamp Co., "Sunbeam." "Regal."
Western Electric Co., "Sunbeam" "Regal."
Westghse. Elec. & Mfg. Co., "Westinghouse."

TANTALUM LAMPS

Bryan-Marsh Co., "Imperial."
Columbia Inc. Lamp Co., "Columbia."
General Elec. Co., "Meridian Tantalum."
Kierulff, B. F. Jr. & Co., "Excelsior."
Holabird-Reynolds Elec. Co., "Femco."
Sunbeam Inc. Lamp Co., "Sunbeam."
Western Electric Co., "Sunbeam."

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Elec. Appliance Co., "Packard."
General Electric Co.
Kierulff, B. F. Jr. & Co., "Excelsior."
Sterling Elec. Co., "Sterling."
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Westghse Elec. & Mfg. Co.

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Kierulff, B. F., Jr. & Co., "Lord Electric Co."
Pass & Seymour.
Pierson, Roeding & Co, "Ohio Brass Co."
Western Electric Co., "Electrose."
Westghse Elec. & Mfg. Co.

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REFRIGERATING MACHINES

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MINING MACHINERY

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Henshaw-Bulkley & Co.
Moore & Co., Chas. C.
Westghse Elec. & Mfg. Co.
Western Electric Co.

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General Electric Co.
Johns-Manville Co., H. W., "Victor Combination."
Ft. Wayne Elec. Works, "Wood."
Wagner Elec. Mfg. Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.
Weston Elec. Instmt. Co.

WATTMETERS

Duncan Elec. Mfg. Company, "Duncan," "Monetary."
Electric Appliance Co., "Sangamo."
Ft. Wayne Electric Works.
General Electric Co.
Johns-Manville Co., H. W.
Wagner Elec. Mfg. Co.
Weston Elec. Instmt. Co.
Westghse Elec. & Mfg. Co.

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ALTERNATING CURRENT MOTORS

Allis-Chalmers Co.
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General Electric Co.
Kierulff, Jr., & Co., B. F., "Ideal."
Standard Elect'l Wks., "Century."
Western Electric Co.
Westghse Elec. & Mfg. Co.

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Elec. Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co.
Fairbanks, Morse & Co.
Standard Electrical Works, "Century."
Northern Electrical Mfg. Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

MOULDING

American Circular Loom Co., "Lutz."
Johns-Manville Co., H. W., "Electrobestos."

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Keirulff, B. F., Jr. & Co., "Di-electric."
Paraffine Paint Co., The "P. & B."
Standard Underground Cable Co., "Ozite."

PINS

IRON PINS

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Harvard Elec. Co.
Kierulff, B. F., Jr. & Co., "Hubbard."
Pierson, Roeding & Company, "Locke."
Roeblings & Sons Co., J. A., "Lima."
Thomas & Sons Co., The R., "Lee."
Western Elec. Co., "Lee," "Fletcher."

WOOD PINS

Kierulff, B. F., Jr. & Co.
Pierson, Roeding & Company, Eucalyptus and Locust.

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IRON AND STEEL PIPE

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Bryant Electric Co.
Electric Goods Mfg. Co., "Howes."
General Electric Co.
Hubbell, Harvey.
Marshall Elec. Co.
Pass & Seymour.
Perkins' Elec. Sw. Mfg. Co.
Stanley & Patterson, Inc., "New Code."

FLUSH PLUGS AND RECEPTACLES

Bryant Electric Co., "Chapman."
Cutter Co., The
General Electric Co.
Hubbell, Harvey.
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.
Stanley & Patterson, Inc., "Simplex."

STAGE PLUGS AND RECEPTACLES

Chase-Shawmut Co., "Cushing."
General Electric Co.
Stanley & Patterson, Inc., "Fielding."
Western Elec. Co. "Krueger"

POLES

IRON AND STEEL POLES

California Pole & Piling Co.
Benicia Iron Works.
Kierulff, B. F. Jr. & Co., "Tripartite."
Pierson, Roeding & Co.

WOOD POLES

California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Sterling Elec. Co.
Western Electric Co.

PUSH BUTTONS

Edwards & Co.
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co
Pass & Seymour.
Western Electric Co., "Edwards," "Midget, Jr.," "New Mite."

RAIL BONDS

Chase-Shawmut Co., "Shawmut."
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Thomas."
Nat'l Conduit & Cable Co.
Pierson, Roeding & Co.
Roeblings Sons Co., J. A.
Westghse Elec. & Mfg. Co.

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General Elec. Co., "Mercury Arc."
Westghse Elec. & Mfg. Co., "Cooper-Hewitt."

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FIELD RHEOSTATS

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General Elec. Co.
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Ft. Wayne Elec. Wks.
General Elec. Co.
Westghse Elec. & Mfg. Co.

SEARCHLIGHTS

Ft. Wayne Elec. Works.
General Elec. Co.
Std. Elec. Wks., "Engberg."

SHADES

Benjamin Elec. & Mfg. Co., Metal.
Dale Co.
Elec. Appliance Co., "Cutter."
Holophane Co.
Hubbell, Harvey.
Pass & Seymour.
Western Electric Co., "Marten."

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Including all classes of Sockets and Receptacles
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Hubbell, Harvey, "Hubbell Pull Socket"
Johns-Manville Co., H W., Moulded Mica W P Sockets.
Marshall Elec. Co., "M.-S"
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Perkins Elec. Switch Mfg. Co.
Stanley & Patterson, Inc., "New Code" W. P.
Weber Electric Co., H D. Sears general sales agent.

SOLDERING MATERIAL

SELF-FLUXING SOLDER

Belden Manufacturing Co.
Dean Electric Co.—"1900."
Kellogg Sw'b'd & Supply Co.
Kierulff, B. F., Jr. & Co., "Di-electric."
Western Electric Co.

SOLDERING PASTE

Belden Manufacturing Co.
Blake Signal & Mfg. Co., "Aluminum Tube."
Chase-Shawmut Co., "Red E."
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F. Jr. & Co., "Dielectric."
Standard Electrical Works, "Standard."
Western Elec. Co., "Hawthorne."

SOLDERING SALTS

Belden Manufacturing Co.
Western Elec. Co., "Hawthorne."

SOLDERING STICKS

Belden Manufacturing Co.
Western Electric Co.," Hawthorne."

STREET CARS

Pierson, Roeding & Co., "Brill."

STAPLES

INSULATING STAPLES

Blake Signal & Mfg. Co.
Kierulff, B. F., Jr. & Co., "Blake."

SUPPLIES

Concentrate your Accounts and Shipments

The following Advertisers carry a general stock of electrical supplies.

Brooks-Follis Elec. Corpn.
Electric Appliance Co.
Holabird-Reynolds Elec. Co.
Pacific Electrical Works.
Standard Electrical Works.
Sterling Electric Co.
Western Electric Co.

SWITCHES

DOOR SWITCHES

Bryant Elec. Co., "Perkins."
Edwards & Co., "Eco," "Lungen."
Marshall Elec. Co., "M.-S"
Perkins Elec. Switch Mfg. Co.
Standard Electrical Works, "M. & M."
Western Elec. Co., "Eco," "Lungen."

FLUSH AND SNAP SWITCHES

Arrow Elec. Co., "Arrow E."
Bryant Elec. Co., "Perkins."
Cutler-Hammer Mfg. Co.
Dale Co.
General Electric Co
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.
Standard Electrical Works, "M. & M."
Cutter Co., The, "C-S"

KNIFE SWITCHES

Chase-Shawmut Co.
General Electric Co.
Holabird-Reynolds Elec. Co
Marshall Elec. Co., "M-S."
Perkins Elec. Switch Mfg. Co.
Std. Elec. Wks., "Barkelew"
Western Electric Co.
Westghse Elec. & Mfg. Co

PENDANT SWITCHES

General Elec. Co.
Pass & Seymour.
Perkins Elec. Sw. Mfg. Co.

SWITCHBOARDS

LIGHT AND POWER BOARDS

Cutter Co., The,
Fairbanks, Morse & Co.
Ft. Wayne Elec. Works.
General Electric Co.
Standard Electrical Works, "Barkelew."
Western Electric Co.
Westghse Elec. & Mfg. Co.

TELEPHONE BOARDS

Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Elec. Goods Mfg. Co., "Annunciaphone," "Rotokoll."
Kierulff, B. F. Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Electrical Works "Couch & Seeley."
Western Electric Co.

TAPE

American Electrical Works
Belden Manufacturing Co. "Century."
Elec. Appliance Co., "Eaco."
General Elec. Co., "Paragon"
Johns-Manville Co., H. W., "Magnetto," "Fibroid," "Niagrite," "J.-M."
Kierulff, B. F. Jr. & Co., "Imperial."
N. Y. Insulated Wire Co., "Grimshaw," "Competition."
Okonite Co., The, "Okonite," "Manson."
Paraffine Paint Co., The, "P & B."
Sterling Elec. Co., "Bear," "Sequoia."
Western Elec. Co., "Victor," "Amazon."

TELEPHONE EQUIPMENT

Dean Electric Co.
Electric Appliance Co.
Electric Goods Mfg. Co.
Kellogg Sw'b'd & Supply Co
Kierulff, B. F., Jr. & Co., "Sterling."
Western Elec. Co.

TOOLS

CONSTRUCTION TOOLS

Kierulff, B. F., Jr. & Co.
Klein & Sons, Mathias

WIRE-CUTTING PLIERS

Marshall Elec. Co., "Economy."
Klein & Sons, Mathias.

TOWERS (STEEL)

Benicia Iron Works.
Kierulff, B. F. Jr. & Co., "Tripartite."
Pierson, Roeding & Co.

TRANSFORMERS

American Transformer Co., "American."
Duncan Elec. Mfg. Co.
Elec. Appliance Co., "Packard."
Ft. Wayne Elec Wks. "Wood."
General Electric Co.
Std. Elec. Wks., "Moloney."
Wagner Electric Mfg. Co., "Wagner."
Western Elec. Co., "American."
Westghse Elec. & Mfg. Co., "Westinghouse."

TURBINES

STEAM TURBINES

General Elec. Co., "Curtis."
Western Elec. Co., "Rateau."
Westghse Machine Company "Westinghouse-Parsons"

WATER TURBINES

Pelton Water Wheel Co. "Pelton-Francis"

TELEGRAPH INSTRUMENTS

Western Elec. Co.

WIRE

ALUMINUM WIRE

Pierson, Roeding & Co.

ANNUNCIATOR AND OFFICE WIRE

American Electrical Works.
Belden Manufacturing Co.
Electric Appliance Co., "Ansonia."
Nat'l Conduit & Cable Co., "National."
Phillips Insulated Wire Co.
Roeblings Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Standard Electrical Works.
Standard Und. Cable Co.
Western Electric Co.

ARMORED WIRE

Sprague Electric Co., "Greenfield."
Standard Und. Cable Co.

ASBESTOS-COVERED WIRE

Belden Manufacturing Co.
D. & W. Fuse Co., "Deltabeston."
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Heany."
Nat'l Conduit & Cable Co., "National."
Safety Ins. Wire & Cable Co.
Western Elec. Co., "Deltabeston"

BARE COPPER WIRE

American Electrical Works.
Belden Manufacturing Co.
Roeblings Sons Co., J. A.
Kierulff, Jr., & Co., B. F.
Nat'l. Conduit & Cable Co.
Phillips Insulated Wire Co.
Pierson, Roeding & Co.
Standard Und. Cable Co.

ENAMELED WIRE

Belden Manufacturing Co.
General Electric Co.
Nat'l. Conduit & Cable Co., "National."
Western Electric Co., "Hawthorne."

IRON WIRE

American Electrical Works.
Belden Manufacturing Co.
Roeblings Sons Co., J. A.

MAGNET WIRE

American Electrical Works.
Belden Manufacturing Co.
D. & W. Fuse Co., "Deltabestnn."
Electric Appliance Co., "Ansonia."
Kellogg Sw'b'd & Supply Co.
Kierulff, Jr., & Co., B. F.
Nat'l. Conduit & Cable Co., "Natinnal."
Roeblings Sons Co., J. A.
Standard Und. Cable Co.
Western Electric Co., "Hawthorne."

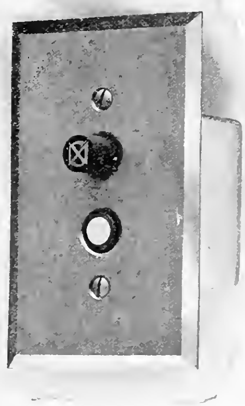
RUBBER-COVERED WIRE

American Electrical Works, "Americanite."
Belden Mfg. Co.
Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Indiana Rubber & Insulated Wire Co., "Paranite."
Kierulff, B. F., Jr. & Co. "National."
Roeblings Sons Co., J. A.
National Conduit & Cable Co., "National."
N. Y. Insulated Wire Co., "Grimshaw," "Raven Core."
Okonite Co., The, "Okonite."
Phillips Insulated Wire Co., "Parac."
Safety Ins. Wire & Cable Co.
Simplex Elec. Co., "Simplex," "Climax."
Standard Elec. Works, "Simplex," "Climax."
Std. Und. Cable Co., "Tip Top," "Marsh," "Sterling."
Western Electric Co., "Habirshaw," "Parac."

WEATHERPROOF WIRE

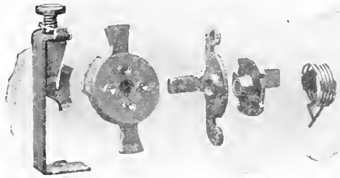
American Electrical Works.
Elec. Appliance Co., "O. K."
General Electric Co.
Kierulff, Jr., & Co., B. F., "Chicago."
Nat'l. Conduit & Cable Co., "National."
Okonite Co., The, "Candee"
Phillips Insulated Wire Co., "O. K."
Roeblings Sons Co., J. A.
Simplex Elec. Co., "T Z R."
Standard Und. Cable Co.
Western Electric Co., "O. K."

30,000 Turns at 50% Overload Marshall Standard Push Button Switches



Here is the latest Marshall Switch.

Looks like others outside—different inside.



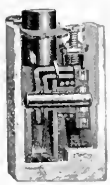
These are the separable parts. Only five of them. The next best has thirteen.

And the Marshall working parts are case hardened steel—genuine case hardened steel.

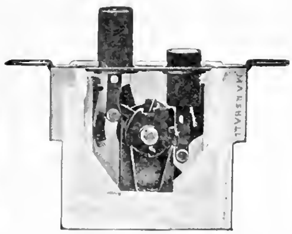
Note that only one piece of metal besides the binding post carries the current. Case hardened bearings shown in the third and fourth pieces are **double length.** They work easier and wear longer. Besides this, after the switch is assembled, the mechanism is **riveted together** and cannot be separated.

Way over on the right hand side is **our** Crucible Tungsten Steel. We underscored ours because it is not used elsewhere and because Crucible Tunsgten Steel is unbreakable and we so guarantee it **forever.**

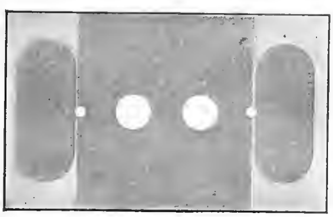
As yet the underwriters only require 6,000 operations, but we guarantee 20,000 and facsimile of the Electrical Testing Laboratories test, which we will send you for the asking, shows that this switch was successfully operated by them 30,587 times 50% above its rated load.



See this section through the switch? Ever see anything like it?

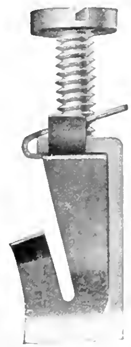


This is the interior, simply a pawl and ratchet. Look at the inside of the face plate a minute.

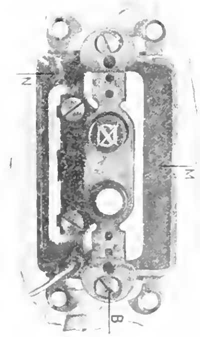


Shaded parts show substantial insulation above binding screws. No short circuits here.

Extra Points



Here is an enlarged view of the bronze locking spring under the binding post which absolutely prevents open currents due to loose connections, saving owners perpetual expense.



Looking down into the interior of the Marshall single pole switch in a Marshall switch case. Please note the extra room gained at the side by the narrow porcelain, which is stronger too.

WE GUARANTEE OUR PORCELAIN AGAINST BREAKAGE FROM ANY CAUSE WHATSOEVER

84 Jobbers have this switch in stock. Ask yours or write on your letterhead for free sample and name of Jobber who has them

PACIFIC ELECTRICAL WORKS, Los Angeles
have them in stock

DUNHAM, CARRIGAN & HAYDEN CO., San Francisco
have these goods in stock

MARSHALL ELECTRIC COMPANY

BOSTON

PIPE ENDS

The Great Money, Stock and Time Savers

HOW TO USE THEM

The entire Pipe Ends system is based on just two hard drawn steel boxes one rectangular (No. 1201 in the $1\frac{1}{2}$" size) and one octagonal (No. 1203 in the $\frac{1}{2}$" size)

The RECTANGULAR BOX has seven openings altogether three knock outs on one side, one in the other side, one in the bottom, and one in each end.

On a given job it is only necessary to determine how many of these you want of each pipe size. As you come to the first place where a box is required, hit the knock out sharply in the middle and drive it in where you want to put the pipe (end, bottom or either side).

To make TYPE "E" (Fig. 4). Strike the knock-out in the end (No. 1201, Fig. 7) a sharp blow with a round nosed hammer and put a nipple (No. 1210, Fig. 1) into the opening from the inside. It has a square head and won't turn round in the box, so you can screw this threaded nipple and box right into the pipe coupling and you have got a straight, neat job, that won't crack or ever give way. Cut (Fig. 4) shows a porcelain cover with pipe drop which, of course, you can put on afterwards, or any cover you want.

To make TYPE "A" (Fig. 5), for Greenfield or Sprague, drive in the bottom knock out, put in nipple No. 1212 (Fig. 2) in the inside, put in duct and set down screw to hold it. The cut shows a cover for Weatherproof wire drop, which does the job better than the old kind.

If you want a TYPE "X," Fig 8 shows how to do it. Cover in this cut is a Marshall 1, 2, 3 wire cover. You can make smooth holes in this cover to suit yourself, too. Simply push out the cement with a screw-driver, where you want a hole.

To make $\frac{1}{2}$" size, TYPE "G" (Fig. 10), which will fit ANY Switch you can find of 5 or 10 Amp. capacity, ANY Receptacle, or ANY Rosette, take Box No. 1203 (Fig. 6), and Universal Cover No. 1232 (shown in Fig. 9). Adjust the tapped holes "A" and "B" by pushing BOTH hinged clips at once with the fingers, in or out, so that it will just fit the fastening holes through the porcelain, then loosen up the two screws in this cover, set it on the box (No. 1203, Fig. 6) so that the clips will extend under the turned over rim, turn it round in any position you want to bring the Switch or Rosette right, tighten up these screws, BEING SURE THAT THE CLIPS ARE TURNED UNDER THE RIM. Next, thread your wires through the Switch, Rosette or Receptacle, fasten it to the box with the machine screws sent with the cover. It will fit any SWITCH, ROSETTE OR RECEPTACLE.

The square nut (Fig. 3) is only used to join two boxes together, end on end, or where in some particular cases a different Sprague bushing is desirable.

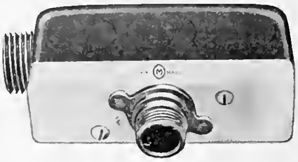
Over 200 different combinations can be made with these two boxes, and don't forget that you can make up anything you want as you go along on the job. No waiting and no dead stock. Sizes, $\frac{1}{2}$-$\frac{3}{4}$-$1\frac{1}{4}$.

We are pleased to answer questions, and will appreciate your suggestions.

No. 1210 (Fig. 1)

No. 1212 (Fig. 2)

No. 1215 (Fig. 3)

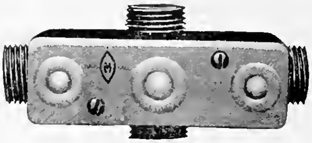


TYPE "E" (Fig. 4)

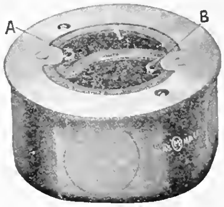
TYPE "A" (Fig. 5)

No. 1203 (Fig. 6)

No. 1201 (Fig. 7)



TYPE "X" (Fig. 8)



No. 1203 and No. 1232 (Fig. 9)

TYPE "G" (Fig. 10)

PACIFIC ELECTRICAL WORKS, Los Angeles have them in stock

DUNHAM, CARRIGAN & HAYDEN CO., San Francisco have these goods in stock

MARSHALL ELECTRIC COMPANY

BOSTON

JOURNAL OF ELECTRICITY
POWER AND GAS

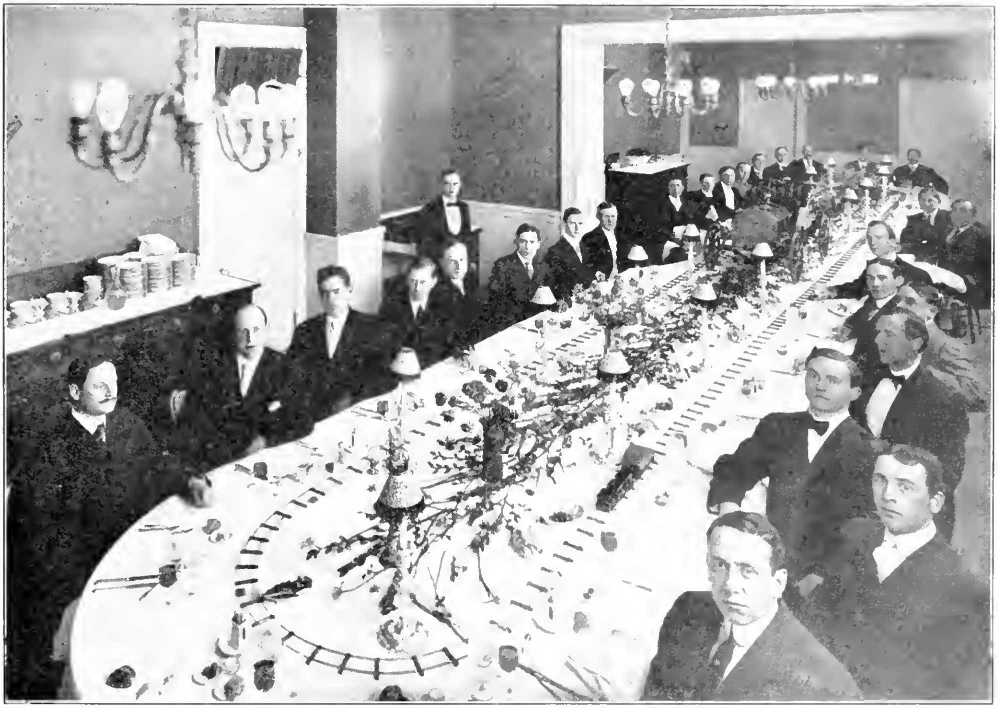
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXII. SAN FRANCISCO, FEBRUARY 27, 1909 NUMBER 9

CONVENTION OF PACIFIC COAST ELECTRIC VEHICLE ASSOCIATION

Responsive to invitation, a number of Pacific Coast representatives of distributers of electric vehicles and their equipment, together with several central station men, met at the St. Francis Hotel, San Francisco, February 19th and 20th, 1909. Excellent papers were read by some of the delegates and a unity power consumer, entitled to low current rates. With cheap electric power assured, sales will be encouraged. The full scope of the organization can be best appreciated by reading the record of the first annual meeting as set forth hereafter.

The Convention was called to order at 10.30 a. m. Friday.



Banquet Given by Electric Storage Battery Company to Delegates Pacific Coast Electric Vehicle Association.

of spirit created that resulted in the formation of a permanent organization to be known as the Pacific Coast Electric Vehicle Association.

The prime object of this organization is to promote the sale of electric vehicles. Its first work is to convince the central station companies of the desirability of battery charging as a February 19th with an address of welcome and explanation of purpose by Mr. R. B. Daggett, manager of the San Francisco office of the Electric Storage Battery Company. During the course of the day papers were read as follows:

"Electric Vehicles," by Mr. R. B. Daggett; "Mercury Arc Rectifiers," by Mr. R. M. Alvord; "Vehicle Batteries," by Mr.

Geo. R. Murphy; "The Relation of Central Station Companies to the Automobile Business," by Mr. Fred T. Kitts; "The Electric Vehicle Motor," by Mr. J. T. De Remer. These papers brought out much valuable information in the course of the discussion that followed them.

For the purpose of effecting a permanent organization the chair appointed as a committee to draw up a constitution and by laws, Fred T. Kitt, A. C. Downing and A. H. Halloran.

In the evening the delegates were the guests of the Electric Storage Battery Company at an enjoyable theatre party given at the Orpheum. Later the party adjourned to the Louvre where a sumptuous supper was spread under the auspices of the Studebaker Company.

Let Watts, Amperes, Volts, all be gone,
Come eat, drink, be merry, join the song;
"Studebaker" as host, desires this to be
An evening for acquaintances, so be free.

The "song" was an appropriate parody on a popular automobile ditty.

A small model automobile was placed at each plate as a souvenir of the occasion and every encouragement given for the promotion of good-fellowship.

On Saturday morning, February 20th, business was resumed with the reading of a paper on "Commercial Electric Vehicles," by Mr. A. C. Downing, and one on the "Electric Garage," by Mr. S. P. Reed. The discussion that followed brought out considerable data on electric pleasure vehicles. The meeting adjourned at one o'clock until the banquet at seven.

"Babcock" Electric Climbing Powell-Street Hill.

During the interim the visitors inspected electric automobiles and their equipment. Several test runs were made by a "Babcock" machine on the Powell street hill. This is one of the heaviest grades in San Francisco and it was demonstrated to the satisfaction of everyone present that the electric automobile is a good hill-climber. Six trips were made in rapid succession, the car taking the heavy grade with ease.

A banquet on Saturday evening was given to the delegates by the Electric Storage Battery Company. The table was beautifully decorated; occupying the center was a large model automobile. An electric car running on a track around the table, supplied with current by a storage battery, carried mes- [illegible] to the guests and caused considerable amusement. Witticisms and fun-making took up the early part of the evening, but at the conclusion of the dinner a report was read from the committee on constitution and by-laws, which reported as follows:

Constitution and By-Laws of the Pacific Coast Electric Vehicle Association.

ARTICLE I.

Name.

This Association shall be known as the Pacific Coast Electric Vehicle Association.

ARTICLE II.

Object.

To promote the use of electric vehicles.

ARTICLE III.

Membership.

Any person or any member or employee of a company engaged in the manufacture of electric vehicles, their equipment or distribution, in the sale of electric power, in furthering the publicity of the same, or any owner of an electric automobile, is eligible for membership in this Association.

ARTICLE IV.

Officers and Their Duties.

The officers of this Association shall consist of President, Vice-President and Secretary-Treasurer, and their duties shall be those usually appertaining to such, except that they shall constitute the Governing Board and shall appoint committees and call meetings.

ARTICLE V.

Elections.

Section 1. All officers shall be elected for the term of one year, except in the case of vacancies, when the term of office shall be for that part of the unexpired term only.

Sec. 2. Any member of good standing shall be eligible for election to any office.

Sec. 3. When from any cause any office shall become vacant, it shall be filled by election as soon as practicable after the receipt of notice of said vacancy.

Sec. 4. Election shall be by ballot, the first ballot being a nomination. The ballots shall continue until one nominee has the majority of the votes of those present.

ARTICLE VI.

Amendments.

Section 1. Amendments to the Constitution can be made by a two-thirds vote of all members.

Sec. 2. Amendments to the By-Laws can be made by a two-thirds vote of the members present at any meeting.

BY-LAWS.

ARTICLE I.

Membership.

Section 1. Applicants who are eligible shall become members upon payment of the admission fee of $5.00.

Sec. 2. The dues shall be $2.00 per annum, payable on March 1st of each year, excepting that charter members shall be exempt from the first year's dues. Those admitted before July 1, 1909, shall be charter members.

ARTICLE II.

Special Meetings.

Special meetings shall be called by the board at their discretion, or upon the application of five members, when no business shall be transacted other than that stated in the call.

ARTICLE III.

Meetings.

Section 1. The regular meetings of the Association shall be held within the first week of February of each year.

Sec. 2. The place of the next meeting shall be determined by the members one year in advance.

ARTICLE IV.

Rules.

Roberts' Rules on Order shall govern the meetings of the Association and the Governing Board, except as otherwise provided for in these By-Laws.

Order of Business.

1. Roll-call.
2. Reading the Minutes.
3. Report of the Secretary-Treasurer.
4. Report of Committees.
5. Unfinished Business.
6. New Business.
7. Adjournment.

ARTICLE V.

Quorum.

A quorum shall consist of fifteen members.

These were adopted and signed by the following, a number of delegates being unavoidably absent:

Geo. E. C. Holberton, San Francisco Gas and Electric Company, 925 Franklin street.

Fred T. Kitt, 316 Twenty-second street, Sacramento, Cal.

A. G. Jones, General Electric Company San Francisco.

A. Scraba, Bay Cities Electric Company, Oakland.

W. N. Stevenson, care of E. R. Braley, Pasadena, Cal.

W. D. Vance, Bay Cities Electric Company, Oakland.

A. C. Downing, Studebaker Company, South Bend, Ind.

R. M. Alvord, General Electric Company, San Francisco.

William Hughes, Bay Cities Electric Company, Oakland.

Geo. R. Murphy, Electric Storage Battery Company, San Francisco.

W. W. Briggs, Westinghouse Electric and Manufacturing Company, 168 Second street, San Francisco.

G. A. McDougald, 568 Fairmount avenue, Oakland.

Sirch Electrical and Testing Laboratories, Los Angeles, California.

Rauch & Lang Company, F. W. Pfaffman, Manager, 2120 West Seventh street, Los Angeles.

I. G. Perin, Western Electric Vehicle Company, Oakland.

"Journal of Electricity, Power and Gas," San Francisco.

R. B. Daggett, Electric Storage Battery Company, San Francisco.

T. H. Dooling, Electrie Storage Battery Co., San Francisco.

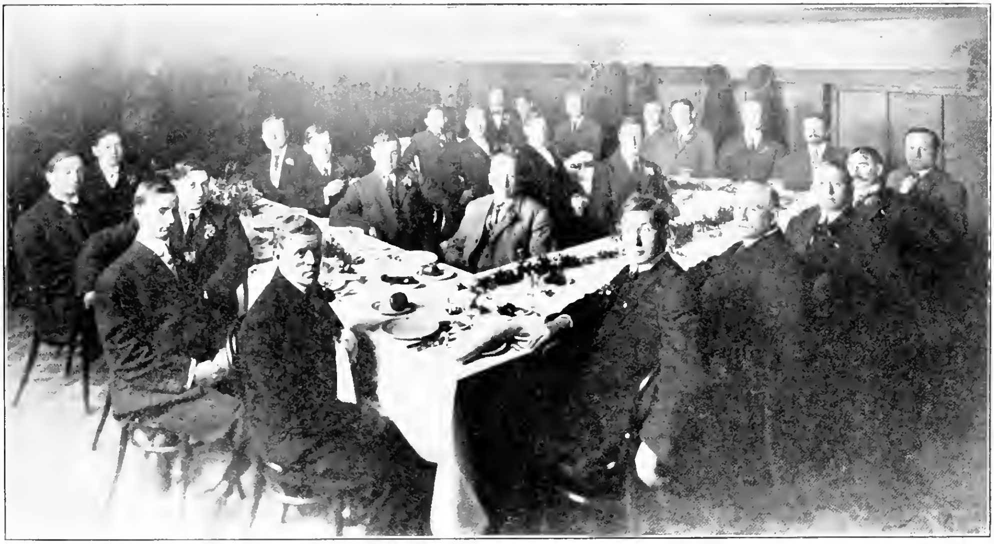
The next business being the election of officers, the following were chosen:

President R. B. Dagget, Manager S. F. Office Electric Storage Battery Co.

Vice-President, A. C. Downing, Manager Electric Automobile Department, Studebaker Bros. Co., San Francisco.

Secretary-Treasurer, A. H. Halloran, Managing Editor Journal of Electricity, Power and Gas.

After a spirited contest, Oakland, California, was selected as the next meeting place. The "Journal of Electricity, Power and Gas" was chosen as the official organ of the Association. The Convention then adjourned after a most enjoyable and successful session. The attendance was about fifty and included representatives from all California.



Supper Given Delegates by Studebaker Bros. Company.

THE ELECTRIC VEHICLE.[1]

BY R. B. DAGGETT.[2]

The electric vehicle has been on the market for about twelve years. It has been prominent during the last eight years. The greatest strides have been made, however, during the last five years.

As is usual with new devices, the first electric vehicles put on the market were crude and imperfect in many particulars. These imperfections reduced their radius of action so that their adaptability was somewhat limited. The battery being the source of power, the blame for lack in mileage naturally attached to its alleged lack in capacity and great weight per unit of output.

The evolution of the vehicle battery will be fully described in the paper to be presented later by Mr. Murphy. You will learn that there has been little change in the type of battery and that the capacity per unit of weight has not been greatly increased during the last eight years until very recently. The new thin type of plate which has been put on the market during the last year has increased the capacity of batteries per unit of weight about 25%, and in some special cases to a still greater degree.

The greatest improvement in the electric vehicle has been made with respect to the design of the moving parts, such as motor, bearings, etc., and also in the quality of workmanship and material. These latter improvements have increased the efficiency of drive very materially, thereby increasing the mileage from two to three hundred per cent with the same expenditure of energy, and hence with the same battery equipment. This increased mileage is due partly to the increased efficiency of operation, thus requiring a smaller amount of energy, and also by decreasing the discharge rate of the battery, thereby increasing the number of ampere hours available.

It may interest you to know the approximate number of electric vehicles in use today in some of the cities throughout the country. I have therefore tabulated them, as follows:

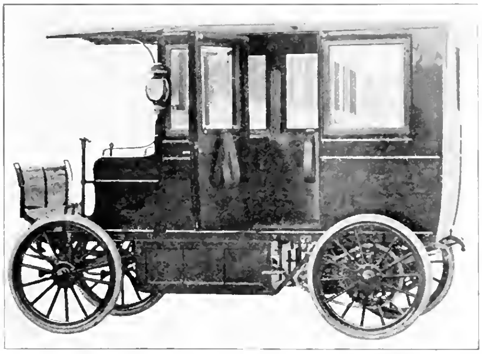
[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Manager S. F. Office Electric Storage Battery Co.

	Commercial.	Pleasure.
New York	900	750
Chicago	50	3000
Boston	71	86
Cleveland	15	850
St. Louis	70	200
Atlanta	..	60
Los Angeles	25	150
Pasadena	..	200
Seattle	5	60
Portland	..	20
Oakland	..	30
Sacramento	..	5
San Jose	..	5
San Francisco	1	5

The two principal uses of electric vehicles are for pleasure and for commercial purposes. The pleasure vehicle will average about 70 miles at ordinary speed on good roads. The commercial vehicle may be divided into two classes—the runabout, having a mileage about the same as the pleasure vehicles, and trucks and delivery wagons, capable of hauling heavy loads, the latter having a mileage of from 25 to 40. The electric truck has demonstrated its value and economy in operation in many cities of the country. The city nearest at hand in which electric trucks have been operated successfully is Los Angeles. The Los Angeles and Redondo Railway Company operates electric trucks for hauling freight, and they have data which indicates that the electric truck is the most economical device for the purpose.

The electric vehicle manufacturers find, on approaching prospective customers for the purpose of convincing them of the feasibility of changing from horse drawn to electrically driven trucks, that the cost of equipment and operation of the electric truck seems large. Upon investigation it is found that the reason for this is, that few companies operating horse drawn vehicles keep records of the costs involved, and that hence the costs are greater than are assumed. This statement applies as well to the lighter forms of vehicles. It is necessary, therefore, for the manufacturer and distributer of electric vehicles not only to study the costs of his product but also that of all other forms of vehicles, in order to put before the prospective buyer a convincing argument.



Electric Bank Wagon or Pay Car.

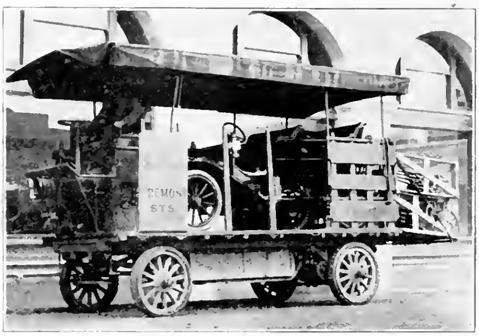
There is practically no competition between the vehicles driven by gas engines and those driven by electric motors. Their fields are quite separate and distinct. The gasoline car is adaptable for touring purposes requiring a large radius of action, whereas the electric vehicle is suitable only for use within a restricted area. Investigation, I think, will show that large numbers of gas engine driven vehicles are used for business and pleasure for short distances in the larger cities. I believe it can be demonstrated that the gas engine driven vehicle can be replaced in many cases by the electric vehicle for city use, with an increase in economy of operation, ease and cleanliness in manipulation, and a decrease in repair bills. Increased cleanliness and superior sanitary conditions of the streets, especially in our largest cities, deserve serious consideration. Power driven vehicles, and especially electric vehicles which are both clean and noiseless as compared with horse driven vehicles, make for the improved conditions along these lines.

In the city of Boston recently, a test of the comparative adaptability of the electric and gasoline vehicles for moving about congested districts was made. A route was determined upon and at the same moment the electric and gasoline started in opposite directions to make the predetermined circuit. The electric arrived at the starting point fifteen minutes ahead of the gasoline car.

Mr. Pfaffman in his paper will bring out the tire problem. Experience has demonstrated that the mileage to be obtained by electric vehicles is largely dependent upon the type of tire used. In fact, the tire problem in connection with all traction vehicles seems to be an important one, and one which is receiving a great deal of attention from the tire manufacturers. Great improvements have been made and no doubt others are contemplated.

The electric vehicle having been demonstrated as a success, the central power station companies furnishing current in the more important cities should at once appreciate the opportunity of greatly increasing their output without materially increasing the capacity and hence the investment on their generating plants.

Electric vehicles are most usually either charged during the middle part of the day or late at night. It is hardly necessary to ever charge vehicle batteries during the peak of the load. Hence, if Central Station Companies can encourage the use of the electric vehicle, they will, at only the expense of advertising, practically obtain storage batteries connected to their system for the purpose of increasing the load when the ordinary demand for current is small. This problem of increasing the load factor is one of the most important ones before the electric power companies today.



Electric Truck Which Has Been in Continual Operation Over San Francisco Streets Since January 10, 1907.

The first move by the Central Station Companies toward encouraging the use of electric vehicles should be their purchase for their own use, for emergency, construction wagons, etc. Many of the larger eastern central station companies have taken this step and I think upon investigation it will be found that not only are they justified in making the purchase for the purpose of convincing the public of the feasibility of operating the electric vehicle, but that these vehicles have increased their economy of operation.

Further methods of procedure suggested are advertising by electric signs and through the newspapers the fact that the company is prepared to make special rates for charging automobile batteries and to at least assist in establishing convenient charging stations throughout their territory.

The subjects above outlined will be taken up more thoroughly in the papers to be presented at this convention, it not being the purpose of this paper to treat any of the subjects mentioned exhaustively, but to direct your thought by bringing to your attention the salient points regarding the electric vehicles.

MERCURY ARC RECTIFIERS.[1]

BY R. M. ALFORD.[2]

Before the introduction of the mercury arc rectifier there existed a demand for a compact, efficient and low cost device for rectifying alternating current for various purposes, particularly for charging storage batteries and electric vehicles. That this demand has been filled by the mercury arc rectifier is evident by the fact that there are nearly thirty-five hundred rectifiers in satisfactory operation throughout the world.

A modern installation of a mercury arc rectifier charging an electric automobile is shown in Fig. 1. It is needless to say that this shows a marked improvement over some of the earlier installations.

The mercury arc rectifier is no doubt the best device that has been produced, particularly on account of its flexibility and reliability in operation and the fact that it is so simple to operate. The simplicity of its operation permits its installation at any point whether skilled or unskilled labor is available for operation, as various letters from users who are non-technical and non-electrical show.

It is not the intention of this paper to go very deeply into the theory of the rectifier. The mathematical demonstration of the law of the rectifier is quite complex, and neither time nor space will permit its discussion. A few simple statements in regard to theory may, however, be of interest.

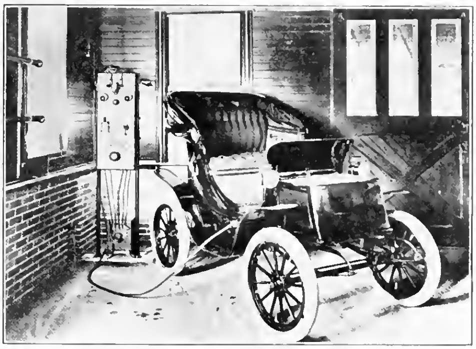


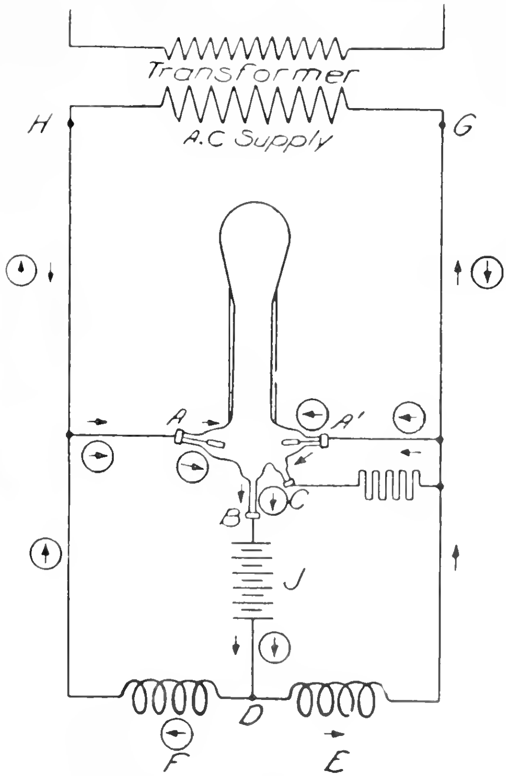
Fig. 1. Modern Automobile Charging Outfit.

In an exhausted tube having one or more mercury electrodes, ionized vapor is supplied by the negative electrode or cathode, when the latter is in a state of "excitation." This condition of excitation can be kept up only as long as there is current flowing toward the negative electrode. If the direction of the voltage is reversed, so that the formerly negative electrode is now positive, the current ceases to flow, since in order to flow in the opposite direction it would require the formation of a new negative electrode, which can be accomplished only by special means. Therefore, the current is always flowing towards one electrode, the cathode, which is kept excited by the current itself. Such a tube would cease to operate on alternating current voltage after half a cycle if some means were not provided to maintain a flow of current continuously towards the negative electrode.

In the General Electric rectifier tube, there are two graphite electrodes (anodes), *A*, *A*[1], and one mercury cathode, *B*, (Fig. 2). Each anode is connected to a separate side of the alternating current supply and also through reactances to one side of the load. The cathode is connected to the other side of the load. As the current alternates, first one anode and then the other becomes positive and there is a continuous flow of current towards the cathode, thence through the load and back to the opposite side of the supply through a reactance. At each reversal the reactances discharge, thus maintaining the arc until the voltage reaches the value required to maintain the current against the counter electromotive force of the load and also reducing the fluctuations in the direct current. In this way a true continuous current is produced with very small loss in transformation.

A small electrode, *C*, connected to one side of the alternating circuit through resistance, is used for starting the arc. A slight tilting of the tube makes a mercury bridge between *B* and *C*, and draws an arc as soon as the arc returns to a vertical position.

That there may be no misapprehension, I wish to emphasize particularly what will be noted from the above, i. e., that the reeifier is designed that the entire alternating current wave is used. This, of course, means that the rectifier has twice the efficiency that would be obtained if only one-half of the alternating current were used.



ELEMENTARY DIAGRAM OF CONNECTIONS
Fig. 2.

An idea of the operation of the mercury arc rectifier may be obtained from Fig. 2. Assume an instance when the terminal *H* of the supply transformer is positive, the anode *A* is then positive and the arc is free to flow between *A* and *B*, *B* being the mercury cathode. Following the direction of the arrows still further, the current passes through the load *J*, through the reactance coil *E*, and back to the negative terminal *G*, on the transformer. A little later, when the impressed E. M. F. falls below a value sufficient to maintain the arc against the counter electromotive force of the arc and the load, the reactance *E*, which has been charging, now discharges, the discharged current being in the same direction as formerly. This serves to maintain the arc in the rectifier until the electromotive force of the supply has passed through zero, reverses and builds up to such a value as to cause *A*[1] to have a sufficiently positive value to start the arc

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]General Electric Co., San Francisco.

between it and the cathode B. The discharge circuit of the reactance coil E is now through the arc A^1 B, instead of through its former circuit. Consequently, the arc A^1 B is now supplied with current, partly from the transformer, and partly from the reactance coil E. The new circuit from the transformer is indicated by the arrows enclosed in circles.

Figs. 3 and 4 give a very good idea of the latest commercial set that has been developed for charging vehicle batteries. The set consists of four essential parts, i. e., panel tube, regulating compensator and reactance.

The panel is entirely self-contained, requiring only to be connected to the secondaries of the supply transformer and to the

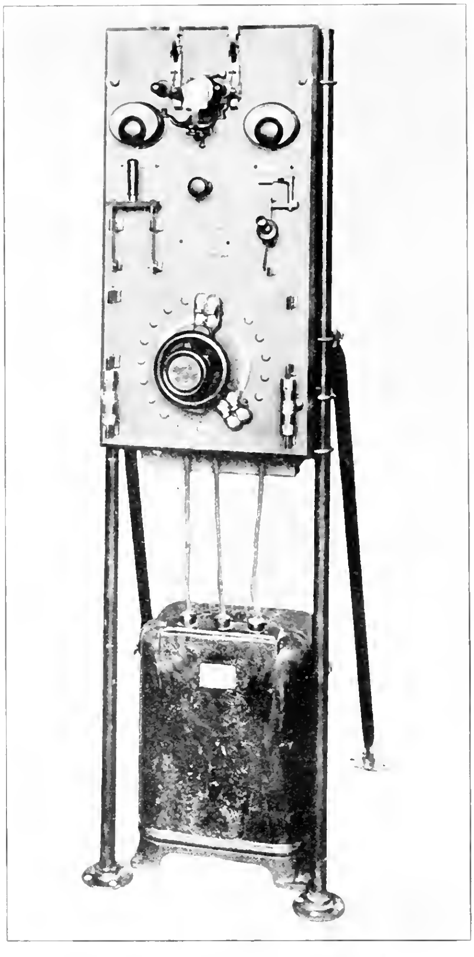


Fig. 3. Front View Mercury Arc Rectifier.

load. Completely equipped, it requires a floor space of approximately 16 x 18 inches, and has a height of 64 inches. On it is mounted a direct current voltmeter and ammeter, a double pole switch for connecting to the supply circuit, a direct current overload circuit breaker for the load, and the necessary switches for starting and operating the rectifier. A starting resistance, on which the rectifier starts before connection to the actual or working load, is mounted on the back of the panel and is operated by a single pole, double throw spring starting switch on the panel. An auxilliary spring switch mechanically operated by this starting switch, automatically opens the starting anode circuit as soon as the starting switch handle is released.

Accurate voltage control is obtained by adjustments of a double regulating switch mounted on the front of the panel. This switch has two sets of contact buttons—six buttons in one set for rough regulation, and eleven buttons for fine regulation. With this switch it is possible to obtain a very wide regulation, practically independently of the current flowing. The contact buttons are connected to rough and fine regulation taps brought out from the regulating compensator mounted on the back of the panel. This is a different form of voltage control than that which has been used heretofore on mercury arc rectifiers, and tests have shown that it is an improvement over previous methods.

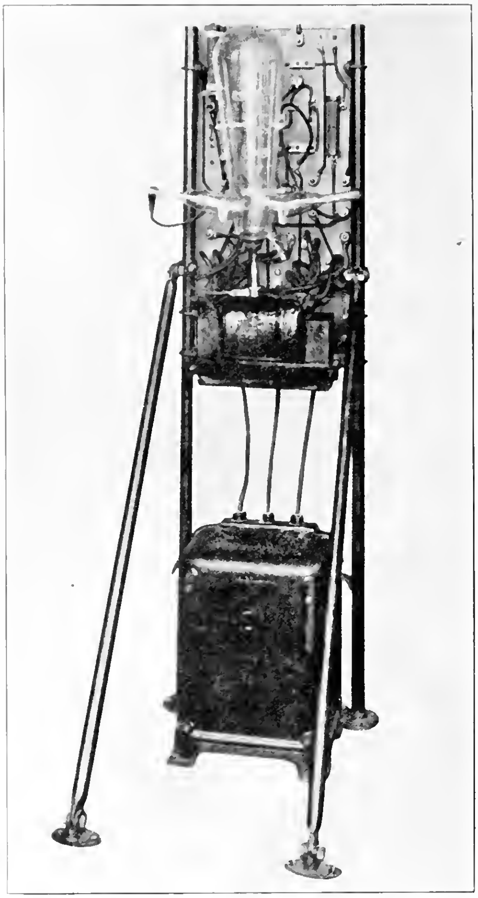


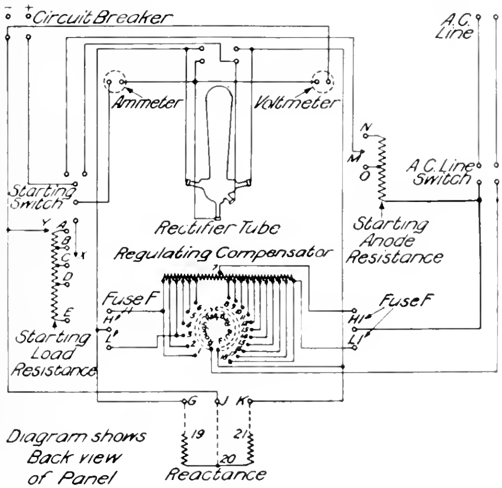
Fig. 4. Rear View Mercury Arc Rectifier.

The rectifier tube is an exhausted glass vessel containing two anodes, A A^1, (see Fig. 2 and Fig. 4), one cathode B, and one starting anode C. The terminals of the tube are provided with metal caps which protect the electrodes, thus reducing to a minimum the liability to damage. The tube is mounted in a holder on the back of the panel consisting of a moving member, so pivoted at its center that it can be rocked back and forth. A small hand wheel on the front of the board is connected to the tube-holder and serves to rock the tube in starting the arc. Two tubes are furnished with each rectifier set.

The reactance is connected directly to the regulating compensator as shown in Fig. 5, and stands on the floor directly under the panel. Three leads are brought out from the reactance to connection studs on the back of the panel.

The rectifier as made for charging electric vehicle batteries and other similar uses, is now furnished in four sizes, i. e., 10 amp., 20 amp., 30 amp., and 40 amp. This covers rectifiers with a single tube. As many as desired may be operated in multiple by the addition of certain auxiliary apparatus.

Rectifiers can be adapted to any commercial frequency and the standard outfits will operate satisfactorily on any frequency from 60 to 140 cycles inclusive. They are designed primarily, however, for 60 cycles, and a maximum direct current voltage will be obtained when operating at this frequency. When operating at 140 cycles the direct current voltage obtainable is somewhat lower. Rectifiers can also be supplied for operation on frequencies of 25 to 60 cycles, inclusive.



Connect G to 19, J to 20, K to 21

110 Volts A.C.

Connect M to O on Starting Anode Resistance

D.C. Volts	Position of Fuses F	Position on Rough Regulating Dial	Connections of Starting Load Resistance	
5 to 15	L - L1	1	Y to A	X to B
10 " 22	L - L1	2	Y " B	X " C
15 " 32	L - L1	3 or 4	Y " A	X " C
20 " 40	L - L1	5 " 6	Y " C	X " D
30 " 44	H - H1	1	Y " C	X " D
42 " 59	H - H1	2	Y " B	X " D
54 " 74	H - H1	3	Y " A	X " D
66 " 115	H - H1	4, 5 or 6	Y " D	X " E

220 Volts A.C.

Connect M1 to N on Starting Anode Resistance

D.C. Volts	Position of Fuses F	Position on Rough Regulating Dial	Connections of Starting Load Resistance	
30 to 64	L - L1	1 or 2	Y to B	X to D
47 " 85	L - L1	3 " 4	Y " A	X " D
60 " 100	L - L1	5 " 6	Y " D	X " E
87 " 117	H - H1	1	Y " D	X " E
110 " 148	H - H1	2	Y " C	X " E
135 " 179	H - H1	3	Y " A	X " E

Fig. 5.

Rectifiers can be furnished to operate on any secondary commercial alternating voltage. The standard outfits, however, are designed for operation on either 110 or 220 volts alternating current, single-phase circuits. It has been found that for a range of direct current voltage from 30 to 115, 110 or 220 volts alternating current will give the best results, although from 110 volts A. C. as low as 5 volts direct current can be obtained.

In Fig. 6 will be found a curve showing the A. C. amperes required when operating a 30 amp. rectifier from 110 volts, 60 cycles A. C.

As the loss in the arc is constant, the efficiency, of course, varies with the direct current delivered, as will be seen in Fig. 6. These efficiencies hold up very high down to one quarter load, which is not true in the case of motor generator charging sets. At the same delivered direct current voltage, practically the same efficiencies would hold on the sets of other capacities previously mentioned. The efficiencies given in the curve, Fig. 6, are correct to within a few per cent.

The power factor as will be seen from Fig. 6, averages over 90 per cent.

The question is sometimes raised in reference to the effect of a pulsating current on storage batteries. This question has been submitted to a prominent storage battery manufacturer who replies as follows:

"We have sifted these matters down from time to time and our conclusion is, that when a given number of amp. hours goes into the battery at a certain rate, it makes no difference when it is plain direct current or the pulsating current from the rectifier." * * * * * *

"There have been so many rectifiers installed in the past few years that we have been enabled to obtain a pretty fair idea of their operation, and if there were any great differences in the effect upon the battery, it is inconceivable that we should not know of it by this time."

The only part of the rectifier set that can require maintenance is the tube. The average life of the tube under normal

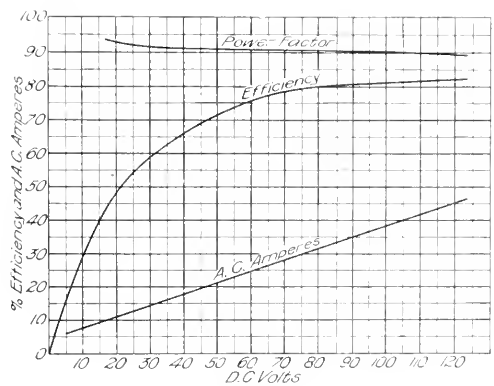


Fig. 6.

operating conditions, is about 600 hours. Tests at present indicate that the average life will be considerably above the figure cited. This will be appreciated from the fact that we have had reports showing a life of over 6,000 hours on a 10 amp. tube; 10,000 hours on a 20 amp. tube; 7,000 hours on a 30 amp. tube; and 6,000 hours on a 40 amp. tube. All these tubes were in commercial operation charging storage batteries.

As the cost of renewals is merely nominal and the other advantages of the rectifier are so numerous, the question of life is not at all serious, but in any case the saving in cost of energy due to the higher efficiency of the rectifier set over a motor generator charging set, is sufficient to pay for a new tube in approximately 300 hours, even in the case of a moderately low voltage battery.

Below is a single example of the saving in cost of operation of the mercury arc rectifier over a motor generator set when charging a 30 cell battery (an average size used in electric automobiles), the battery being charged in accordance with time and current recommended by the manufacturer.

Motor Generator Set.

The first part of charge is at 19 amp. and 70 volts average for 5 hours. Efficiency of set at this load—50 per cent.

Second part of charge is at 8 amp. and 74 volts average for two hours.

Efficiency of set at this load—33 per cent.

First part of charge=19x70x5=13.3 k.w. hrs. from service mains. 50%

Second part of charge=8x74x2=3.58 k. w. hrs. from service mains 33%. Total 16.88 k.w. hrs. from service mains

When figured at 6 cents per k. w. hour equals 16.88x.06 equals $1.01 per charge.

Mercury Arc Rectifiers.

The first part of charge=19x70x5=8.52 k.w. hrs. from serv. mains 78%
Second part of charge=8x74x2= 1.48 k.w. hrs. from serv. mains 80% Total 10.00 k w. hrs. from serv. mains
When figured at 6 cents per k.w. hour—10x.06—$.60 per charge.
Cost per charge—motor generator set............$1.01
Cost per charge—mercury arc rectifier............ .60

Saving per charge .... .41

With an average life figure of 600 hours, 7 hours per charge equals about 85 charges during life of tube.

Total saving during life of tube equals .41 x 85 = $34.85.

In this particular example the saving is sufficient to pay for a new tube in about 225 hours.

General experience has shown the rectifier to be durable and satisfactory in operation, and there is no doubt but what it has helped materially towards increasing the popularity of the already popular electric vehicle. This is probably due to the fact that it makes possible for the electric vehicle owner to charge at home, which no matter how near by or well fitted a public garage may be is a great convenience.

For charging a number of automobiles in electric charging garages, the panel shown has been designed. While the exact method will differ with the conditions, the plan consists briefly in charging a number of vehicles connected in series multiple.

VEHICLE BATTERIES.[1]

BY GEORGE R. MURPHY.[2]

If a piece of copper and a piece of zinc are placed together so as not to touch each other, and immersed in dilute sulphuric acid in a cup, current will flow through a circuit connecting the copper to the zinc. This is one of the simplest forms of primary battery cells. The current is produced by the sulphating action of the sulphuric acid upon the metal. If by sending current through the circuit in the opposite direction, the plates could be restored to their original condition, this cell would become a secondary or storage battery. This particular restoration, however, is not possible and other materials have to be used.

In 1860, a Frenchman, Gaston Plante, found that a storage cell could be produced if the plates were both made of lead, one of them coated with peroxide of lead and the other with sponge lead. His method of producing the coating was by corroding the body of the lead plates by the action of the current, and by frequent reversals the coating becomes thicker and the capacity of the plates increased. In 1880, another Frenchman, Camile Faure, and an American, Charles F. Brush, almost simultaneously, made plates by applying oxides of lead in the form of a paste to the lead blanks or "grids." By a single long charge the plates could be immediately formed without the necessity of the deep corrosion necessary to obtain capacity from the Plante type of plates. In the course of time, both types of plates have been developed and improved, the Plante plates being made with corrugations, grooves, etc., to increase their surface, and a rapid electro-chemical process has been developed to shorten the time necessary to produce the requisite amount of corrosion on the surface of the lead.

The pasted type of plates has been refined by developing different mixtures of paste to regulate its porosity, and numerous forms of grids have been worked out with the idea of reducing the weight, resisting corrosion, and forming a durable positive support for holding and locking the paste or active material in its position. Plates of both the Plante and the pasted types are today extensively used, but, in general, plates of the Plante type are used for stationary batteries, such as in the regulation of power plants, whereas, in automobile work, the pasted type of plate is used almost exclusively.

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Engineer Electric Storage Battery Co.

The earliest commercial application of the storage battery for automobile propulsion was made in 1899, with a battery of modified Plante type, but it was not long before the makers of this battery—"The Chloride Accumulator"—foresaw the necessity of a battery for this purpose having more capacity and less weight and they started to develop one of the pasted type. This battery has become known as the "Exide" and is a development of the Bradbury-Stone type of grid. The earliest types of the Bradbury-Stone grids looked like a checker-board—the white squares of the checker-board representing one face of the plate and the red squares the other face. The two faces are united by ribs, or strips, running lengthwise, so that when the plate is pasted the paste is held in the grid in the form of a pencil between the vertical ribs and locked in place by the checker-board squares on each face. The whole grid was surrounded by a frame. This grid was heavy and a large portion of the surfaces of the active material was covered over and the next Bradbury-Stone improvement was in lightening the grid and exposing more of the surface of the active material. The checker-board squares have been much reduced in one dimension, bringing into prominence the longitudinal ribs and making the pencil of active material more pronounced.

The next development was in bringing the cross-bars on each side of the plate into alignment with each other while still maintaining the staggered relation with respect to the bars on the opposite face of the plate, and in further reducing the section of bars until the present type of plates were adopted.

The positive and negative grids are of the same design but the bars of the negative plate are lighter than those of the positive. The negative plate is also somewhat thinner than the positive.

In mounting the plates to form a cell, it is customary to use one more negative plate than there are positives so that both faces of each positive plate are active. The positive and negative plates are placed side by side alternately, with a space of about three-sixteenths of an inch between the faces of each positive and negative plate. Each plate is supplied with a neck or extension, called a "lug," at one upper corner and all the lugs of the positive plate are arranged to come out in alignment at one side of the jar and the negative lugs the other side. The plates are kept from touching each other by separators, placed in the spaces between the plates. The best material for separators has been found to be specially treated wood, which is grooved longitudinally on one side so as to give free circulation from the bottom to the top of cell. The flat side of the wood separator is placed next to the negative plate. The ribs of this wood separator in the standard assembly are not allowed to touch the positive plate since the highly oxidized surface of this plate has a tendency to char the wood if the latter is pressed up against it. There is, therefore, placed between the ribbed side of the wood separator and the positive plate a thin sheet of perforated hard rubber. This sheet of rubber is so very thin and contains so many perforations that the action of the electrolyte upon the plate is very little obstructed, and this rubber sheet in addition to the function already noted, is advantageous in preventing the washing out of the paste from the positive plate.

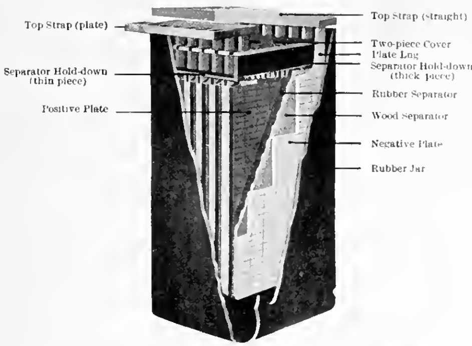
The positive plate lugs are all united together, as are also all the negative plate lugs, in each cell by straps, which consist of flat strips of lead or lead alloy having rectangular openings which are spaced to register with the lugs. The straps are furnished with projections which form the connections for the cells and are of three general types. The "L" strap is of the low-burned type, so called because the burning is below the level of the top of the jar, the post of the strap extending above the top of the jar. Where covers are used with this type the cover rests on the top of the strap and below the top of the jar.

The top straps are of the high-burned type, so called because the plate lugs extend above the top of the jar, the strap for the positives of one cell being in one piece with the strap of the negative plates of the adjoining cell, the strap itself thus making the connection from cell to cell. When the cells are arranged side by side the straight strap is used, and when arranged end to end the plate strap is used. When the covers are used with this

type of strap they are slotted to fit the plate lugs and rest in auxilliary supports placed on top of the plates.

The pillar type of strap is of the low-burned type, and the cells are connected by links burned to the neck or pillar, forming a part of the strap. The aprons extending from the lower side of the strap are to keep the wood separators from floating, which they sometimes have a tendency to do, especially when the cell is subjected to the violent vibration and jarring encountered in automobile service.

The accompanying illustration show two cells, one of which is assembled with pillar straps and the other with top straps. In the latter cell, the arrangement for holding the separators in place and supporting the cover is clearly shown, and in both cells, the arrangement of all the parts with respect to each other can be readily followed, by reason of the parts being broken away to show how they go together.



Cell Equipped With Top or High-Burned Straps.

Cell Assembled With Pillar Straps.

In mounting cells for the propulsion of automobiles, the necessary number to constitute one group are placed in a tray. The pillar strap is mostly used for cells of the smaller sizes, up to 35 amperes for four hours and the top strap is mostly used for cells of larger size, or in other words, the pillar strap is mostly used in pleasure vehicles or light commercial delivery wagons, and the top strap in heavy commercial vehicles. In commercial vehicle service covers for the cells are often dispensed with, as the batteries are usually worked more constantly and require more frequent inspection. For pleasure vehicles it is usually desirable to provide covers sealed in place, and the pillar strap is a little better adapted for this than is the top or the "L" strap.

Batteries for automobile work are rated at their 4 hour discharge rate. For instance, the 9 P. V. cell is rated at 24 amperes for 4 hours, the 11 M. V., 35 amperes for 4 hours. It is necessary to qualify the capacity of a cell by the rate at which the discharge is taken, since the capacity varies with the rates. A 11 M.V. cell can be called a 140 ampere hour cell, or a 161 ampere hour cell, according to whether it were rated at its 4 hour discharge capacity or its 8 hour discharge capacity. The Exide propulsion cells are rated at their 4 hour basis because that is the rate usually averaged under service conditions on the vehicle. The lower the rate of current the higher the capacity and conversely, the higher the rate of current the lower the capacity in ampere hours. At the lower rates of current the average voltage obtained during the discharge is higher, so that the watt hour output at the different rates varies even more than does the ampere hour capacity. This point is of the utmost importance in showing the necessity of keeping the automobile in the best possible condition so that it will consume the lowest possible current. If, by reason of poorly lubricated bearings or a binding brake, the current consumption of the vehicle is increased, the capacity of the battery, or in other words, the mileage which the vehicle can make is reduced in much greater percentage than that by which the current is increased. In many cases, the mileage is still further reduced by the characteristic curve of the motor, whose maximum efficiency is probably somewhere near its normal operating current, and may fall off quite considerably as the current is increased. The final voltage to which a battery can be safely discharged varies with the rate of current. The voltage during discharge is higher at the beginning and lower at the end and falls quite rapidly towards the completion of the discharge. If discharge were at the 4 hour rate the voltage at the start would be somewhat over 2 volts and at the completion would be about 1¾ volts. If the discharge current were at a lower rate the voltage would be higher throughout the entire discharge, and conversely. If the discharge current were irregular the voltage would be irregular and unless the current value and the voltage of this particular current were known it would be extremely difficult to determine from the voltage the extent to which the battery had been discharged. There is, however, an additional check upon the capacity of the battery due to the change in the specific gravity of the electrolyte. If, when the battery is fully charged, the electrolyte has a specific gravity of 1.28 it will drop to about 1.17 after its 4 hour capacity has been taken out. This drop in specific gravity is a straight line at a uniform rate. A given drop in acid density will correspond to a given number of ampere hours of discharge, irrespective of the rate of current. For this reason, the specific gravity is a much more reliable indication of the condition of charge or discharge, than is the voltage at any given time. In charging at constant current the voltage scarcely rises for a considerable period toward the beginning of the charge, after which the rise is gradual and towards the end becomes more sudden till it reaches its maximum point when it becomes constant. The specific gravity rise through the greater part of the entire charge is uniform but tapers off more gradually as it reaches its maximum value.

It is always necessary to put into a storage battery more ampere hours than have been taken out of it in order to fully charge it. The ampere hours which are lost are used up in forming gas—free oxygen being given off from the positive plates and free hydrogen from the negative plates. The amount of gas lost is greater with high charging current than with the lower rates. This gassing is to be minimized as much as possible not only on account of the loss in efficiency but also because the free gas being liberated causes circulating currents in the electrolyte which tend to wash out the active material from the plates. If there were no gassing until the cells became fully charged, then, at

a constant current the acid density would rise uniformly throughout the entire charge until it reached its maximum and would then hold this maximum, forming a sharp point in the curve.

Under proper service conditions the capacity of an Exide cell will increase with use. The Exide cell is rated at its initial capacity and as the cell is worked this capacity begins to increase until the cell which at first had a capacity of 4 hours may have a capacity of from 4½ to 5 hours at the same rate of current. This is due largely to the action of the active material on the positive plates, which, with working, becomes more porous and open at the surface. With use, however, this more porous surface material gradually becomes softer and the material nearest the surface, which is the softest, becomes washed out. After a time, a balance is arrived at when the increase of this capacity is neutralized by the loss of material and at this period, the capacity remains constant at its maximum value. In a short time however, the washing out effect becomes greater than the effect due to the opening up of the material and the capacity gradually falls off. The falling off, however, is much more gradual than the rise, until the material is very much washed out, when the plate is rapidly nearing the completion of its useful life.

The rise in capacity at the beginning is quite rapid and becomes less rapid as the life progresses. If the life had been started sooner, the gain in *life* would be very little, whereas, the loss in capacity would be comparatively very great. If, however, the life were started at the point of maximum capacity, although the initial capacity would be considerably higher, yet the amount of life lost would be considerable. There is thus shown a reason for rating the Exide cell on its present conservative basis. Very often other types of batteries have been rated at their maximum capacity, and in making comparative tests of different makes of batteries, the capacity characteristic during the life should receive very careful consideration.

There is often some doubt in the minds of the battery operators as to when a plate should be thrown away as worn out. If the thin portion is entirely washed out in any place, the general rule may be applied that the life remaining in the plate is not enough to warrant the expense of reinstalling the same positives. If, however, the washed out portions on either side of the plate do not meet so that there is a solid film of active material all over the plate, then, in general, the amount of life left in the plate will pay for putting it back into service.

It is difficult to express the life of a positive plate in any general terms; but, under any definite conditions of service, the life is, practically proportioned to the number of charges which the plates receive, but the life in actual number of charges varies with different users—some users getting over 350 charges, others not much more than 200.

It is very important that the battery be cleaned and all the sediment be removed from the bottom of the cells before it reaches the plates. Once the sediment reaches the plates, there is a discharge of wasted current through it, which necessitates more charging in order to obtain satisfactory capacity. This extra charging throws down more sediment. In addition, the sediment becomes sulphated and by local action with the active material of the plates in contact with it, causes the active material to become sulphated; this again furthers the tendency to increased washing out. The net result is that the plates begin to wash out much more rapidly if the sediment is allowed to deposit up to the top of the ribs in a jar. It is an excellent plan after a battery has been charged a certain number of times to cut out an element to determine the rate at which the sediment is being thrown down and to use the rate so obtained to determine a time at which it would be advisable to clean the battery and not to wait until the battery shows some positive indications of need of cleaning before giving it attention. For example, if we take the type of cell having ribs in the bottom 1¾ inches high and use the figures already assumed for the cleaning periods, we will, say after the battery has been in service for 50 discharges, cut out an element and find it has deposited ¾ inch of sediment in the bottom of the jar. We do not want to allow the sediment to get 1¾ inches deep and we therefore decided that the battery shall be cleaned when the sediment reaches 1½ inches. Since after finding ¾-inch sediment in 50 discharges, we will assume that it will take another 50 discharges to deposit the additional ¾ inch and so we decide to clean this battery after it has been charged 100 times. If under the same conditions we found that 1 inch of sediment had been deposited, we would decide to clean the battery after it has been discharged a total of 75 times. Operating under these conditions, we are pretty well assured of being able to keep ahead of the sediment. It is always advisable to make an allowance such as the ¼ inch assumed in the foregoing example, as there is apt to be some little variation in different cells and without cutting every cell apart, it would be impossible to determine the exact condition of every cell. The sediment will also deposit more rapidly during the latter part of a period than at the beginning.

The desirability is often expressed of having a battery possessed of greater capacity, for unit of weight, than that of the standard Exide. Probably the simplest way of increasing the capacity is to fill the plates with a more porous active material. This gives a greater active surface to the plate and consequently greater capacity. A plate of this kind, however, rapidly loses its active material, since, as can be readily understood, it is less coherent and will soften up much more rapidly than dense material. A better method of increasing the surface is to make the plates thinner and use more of them. In this way, we are able to obtain increased surface while still maintaining a dense and coherent active material. A thinner plate, however, will not have as great a life, expressed in discharges, as one of standard thickness, as there is less thickness of material for the washing out process to work on. The capacity on each discharge, however, for the complete cell is greater with the thin plates and although the life in discharges is shorter, yet the life expressed in ampere hours or in other words, the total mileage obtained would be about the same as that of a standard cell of the same weight if the full capacity were taken from the thin plates on every discharge. If a standard jar were filled with plates of one-half of the standard thickness and we should use twice the number of plates, the weight of the cell would be about the same. Although there are twice as many plates and twice the apparent surface, the capacity would not be twice that of the standard cell, because the thin plates do not contain twice as much material as the standard plates. A plate of one-half the thickness will not have the same capacity as a plate of standard thickness, but it will have *more than half* the capacity, and it is for this reason that the thin plate cell will have the higher capacity.

The Sparking battery uses plates of the standard Exide type though of special height. These plates have given excellent results in this kind of service. A practical sparking battery should not only contain good plates, but even the best plates are not serviceable unless they are mounted in a manner which will insure satisfactory results under the conditions to which such batteries are exposed. It is especially necessary that all parts should be hermetically sealed to prevent splashing of the electrolyte and consequent corrosion of the wires and terminals and other damage. The parts must be rigidly mounted or the connection will not be maintained under the severe conditions of vibration and knocking around which these batteries receive. These batteries usually consist of three cells mounted as one unit in a wooden box by imbedding the jars in compound which is poured into the box around them. The elements are mounted with wooden separators, covers and pillar straps. The covers are sealed and the compound is flooded over the entire top level with the top of the case to the pillar strap of the positive group of one of the end cells and to that of the negative group of the other end cell are burned extension terminal lugs which come up out of the compound for the attachment of the connector bolts. Beneath the compound, the terminals have a flange to anchor them in place and prevents creeping of the electrolyte at this point. The cover of each cell is fitted with a hard rubber tube extending through the compound, through which the cells can be inspected and the electrolyte kept to its proper height. These tubes are

closed by a special vent cap, which, although it allows the free escape of the gas, is designed to catch any splash or spray and return it to the cell. This is accomplished by providing the cap with a downwardly extending cone in the upper part of which are holes to allow the escape of gas, while in the apex is a hole to allow the return of the liquid. The case is provided at either end with buttons to which are attached a strap of rubber fabric for lifting and carrying the battery.

In manufacturing storage batteries, it is necessary not only to produce the best material possible, but to make every cell and every plate and part uniformly good. It is not only necessary that the material should be of proper purity and be properly put together, but in order to obtain the best results, it is necessary that the user be just as careful to properly install and operate his batteries. Upon receipt of the material it should be examined for breakage and foreign matter, and should then be erected in accordance with the instructions which are sent with each battery. In order to start the battery off properly, it should be filled with electrolyte of the proper specific gravity and the initial charge given until the battery is fully charged. The initial charge requires to be of a capacity several times that of the ordinary discharge capacity, as, without this, the plates cannot be brought up to a state of complete charge. If they are not brought up on the initial charge, the probabilities are that they will never be fully charged, and a certain amount of sulphate will remain in the plates which will produce local action and materially shorten their life.

In regular operation it is best to charge at the lowest rate possible. As already pointed out, the principal wear on the plate is caused by the gassing during the charge. As this gassing is reduced by a lower rate of current, the wear on the plates is correspondingly reduced. Since the gassing occurs most towards the completion of the charge it is at this point that it is most imperative to have the current low. The rate of charge is usually limited by the available time and in order to get the necessary number of ampere hours, into a battery in a given time with the least wear, the current should be high at the beginning of the charge and low at the completion.

There is very little affect of current rate in discharge upon the life of Exide cells. In discharging at a high rate, less capacity is obtained that if discharged at a low rate, expressed in ampere hours. The effect of discharging at a high rate is, therefore, somewhat similar to a partial discharge at a low rate.

It is a fortunate thing that batteries give best results when operated at temperatures most comfortable to human beings. There is no particular harm done to a battery by extremely low temperatures although the capacity is reduced as the temperature is lowered. The effect of lowering the temperature is much the same as that of increasing the discharge current, both the capacity and voltage being lowered. As the temperature is increased above the normal, however, the capacity is increased but the tendency to sulphate and to injury by local action becomes greater. High temperature has much the same effect on a battery as that of increasing the specific gravity of the electrolyte. If the electrolyte is weakened, there is, unless the specific gravity is very low, little serious damage done, the capacity merely being reduced. If, however, the electrolyte be too strong there is an increase of capacity, but also an increase in local action and a tendency to sulphate. The same effects are produced by high temperature.

There is often much more strong electrolyte in the cell than is shown by the hydrometer readings. Such a condition exists when a battery has not been sufficiently charged, either at the beginning of its life or at subsequent periods. There is a resulting accumulation of sulphate in the plates which causes a gradual reduction in the specific gravity of the electrolyte. The cause not being understood, the gravity is brought up by the addition of a stronger solution and thus the trouble is further aggravated until, finally, a marked deficiency in capacity causes complaint. Batteries in this condition require a very long time of continual charging to reduce all the sulphate, and this time is required even though a high current rate be used. There are two reasons for keeping the current low under these conditions. In the first place, the time for bringing the battery into shape cannot be reduced and a large proportion of the current is wasted, in addition to which, there is an unnecessary wear on the plates. Badly sulphated batteries, although their voltage on charge may be high, do not show increase in specific gravity until they have been charged for several hours. As the gravity begins to come up, there is also an increase in the voltage due to increasing the conductivity of the plates, since sulphate is a poor conductor. It is not until the specific gravity and the voltage have reached a maximum point, determined by taking several successive readings at intervals, that the battery can be considered brought back to its proper condition. The abnormally high voltage reading at the beginning of the process is due to resistance but at the completion, the voltage rise is due to counter E. M. F.

It is rarely necessary to add anything but water to the cells between the time of cleaning and it is usually in cases where there is much splashing or where there are leaks in the cells that acid has to be added. Although the sediment, by sulphating, absorbs some acid, this is not enough to make more than a few points difference in the specific gravity.

For propulsion batteries, a specific gravity of between 1.27 and 1.28 is recommended when the batteries are fully charged. Before the battery is assembled, the plates are in a somewhat sulphated condition and it is therefore necessary to fill them initially with electrolyte with a low specific gravity. Where wood separators are used, this electrolyte is 1.20, and where all rubber separators are used, it is 1.16. In no case should electrolyte be allowed to become higher than 1.30 when the cell is in a state of *full* charge and the plates are absolutely free from sulphate.

The instruction books furnished by The Electric Storage Battery Company have been revised from time to time, and the Exide book is now in its sixteenth edition. Boiled down, the most important rules to be followed are as follows:

1. Keep the electrolyte above the top of the plates.

2. Do not allow the batteries to remain an unnecessary moment in a discharged condition and at intervals see that the battery is charged to its maximum.

3. Never replace evaporation with any thing but pure water.

4. Do not make a practice of charging batteries when only a small percentage of their capacity has been taken out. This rule, however, may be modified in the case of batteries standing with little or no work, in which case, they should be freshened by charging from time to time to prevent their sulphation from local action.

Creosote treatment of loblolly pine telephone poles has been so successful that the Louisiana Creosoting Company has been formed to operate commercially the plant designed by the Forest Service. The treating plant, which has been in operation since the latter part of October last, is of the "non-pressure," or "open tank" type. The installment of this type of plant costs much less than a plant of the "pressure" type, which is the ordinary type of plant for commercial purposes throughout the country. The "open tank" system depends fundamentally upon the immersion of timber first in a hot bath of the preservative, followed by a rapid change to a cold bath. This method does away with the installment of high pressure and vacuum pumps and a treating cylinder of massive construction to withstand a high internal pressure, which are necessitated by a plant of the pressure type. It is usual, however, to install a treating cylinder of light construction where any great quantity of material is to be treated, since the cost of handling the material and loss of preservative through volatilization during the hot bath is in this way reduced to a minimum. Extensive experiments carried on by the Forest Service in recent years, have shown that the "open tank" system is admirably adapted to the treatment of certain classes of timber, and especially so as regards loblolly pine.

RELATION OF CENTRAL STATIONS TO THE AUTOMOBILE BUSINESS.[1]

BY FRED E. KITE[2]

We are all more or less familiar with the central station term "peak," which denotes the time of maximum demand upon the station for power. Ordinarily, the daily load curve of the central station approaches the peak in the early evening and usually continues but a comparatively short time.

One of the big problems, the satisfactory solution of which spells success for the central station, is the question of "peak load." It is obvious that sufficient capacity in generating machinery, prime movers, distributing copper and auxiliary apparatus must be provided to meet this maximum demand without regard to what the ordinary demand may be.

A central station which is able to so dispose of its energy that the peak load is low, compared to the continuous load, can afford to sell its products at a much lower rate than the price which must be asked by the station that has a high peak.

The occurrence of a peak may be avoided to some extent by encouraging long hour customers, by dividing the load between the customers using power at different times of the day, and by storing energy during the hours when the rates of consumption of energy is low.

Since the electric motor has come into such popular favor, the method of dividing the load between power users which consume during the day, and lighting customers which demand power only at night, has become almost automatic. No matter how much power load is developed, however, the peak is always noticeable. Even if the power load should exactly equal the lighting load and the time of dropping off the one would coincide with the taking on of the other, an ideal condition which could never be realized in practice, the only result would be to flatten the peak, or in other words, the peak would come on as the power load came on in the morning and continue until the lighting customers began to discontinue their lights at night. While this would be considered a very good load and power could be sold at a very low rate, still much of the apparatus of the station and distributing system would be idle from a comparatively early hour in the evening to the following morning. As interest charges, depreciation and other expenses come on night and day, it is desirable to keep all the equipment earning something for the full twenty-four hours.

The best solution then seems to be a combination of these methods. Storing electrical energy is best accomplished by means of the storage battery, although other systems have been proposed, such as pumping water from a low to a high level during hours of light load and allowing it to fall upon water wheels during hours of heavy or peak load.

On this coast where a great part of the energy is produced by water power, the question of securing load after the evening peak is even of more importance than where fuel is used. When the peak is off in a steam plant the fuel consumption is also less, while in a water power plant water usually goes to waste when the load drops off.

With our modern system of alternating current distribution, storing energy by means of the storage battery requires not only the battery but the converting and auxiliary apparatus as well.

Electric vehicle batteries are nearly always charged late at night, and as the customer owns his own battery and converting apparatus and uses power at a time when both the motor consumer and the lighting customer have gone off the line, they are the most desirable customers.

Many of the central stations do not as yet make a sufficiently low rate for this class of business, which fact must be due to their not having considered the question carefully, and I think most of them could be brought to see the advantage of selling energy off the peak to be used for pleasure vehicles, delivery wagons and trucks during the day, and would make a rate low enough to encourage the adoption of electrically propelled vehicles to such an extent that their revenue would be materially increased.

It is certainly gratifying to those interested in the electric automobile business, to know that their goods have been so perfected that they are now becoming an actual necessity, not only for the purpose of passenger transportation but also for transporting freight on the streets of our cities.

The electric pleasure vehicle has already displaced thousands of horses and the modern electric truck is now coming in favor so fast that it will not be long until horse drawn vehicles will be the exception, and when we see the thousands of horses still plodding along our streets we can see the tremendous demand there will be for the product of the central station when these changes are made. It is also pleasing to us to know that the central station people are beginning to realize the great opportunity that the electric vehicle business has to offer them and that they are fast becoming convinced that a little effort spent in encouraging the use of such vehicles will be handsomely repaid by a permanent and desirable load connected to their mains, the securing of which requires practically no extra investment on account of the fact that practically all the energy used for charging vehicle batteries is used when the load on a station is light and the station apparatus would otherwise be idle.

Many central stations are spending thousands of dollars for maximum demand indicators and other devices, and are using complicated systems of accounting to improve their load factor that are now finding out that the electric vehicle in combination with other motors are solving the problem automatically. One customer may have a high maximum demand on a lighting load, another on a power load, another on a vehicle battery. The resultant of all these tend, not only to keep down sharp peaks in the load curve, but, on account of this improvement of the load factor, the station may make a lower rate on all of its energy, thus encouraging greater consumption and receiving a larger income.

The central station people in looking back over their experiences can see where the popular use of the electric motor has enabled them to reduce the price of energy in general, and I am sure none of them regret the encouragement they offered to the power business at a time when it was not so well developed as it now is, for it has built up for them a day load which keeps the station and distributing apparatus earning something during the day as well as during the evening. And now comes the electric vehicle. During the day when the station is supplying energy for industrial purposes, and during the evening when its products are being used for lighting, the electric vehicle is busy using up energy stored the night before and is willing to wait until the lighting customers are satisfied before again making any demand on the central station.

For this reason the central station should make a very low rate for vehicle battery charging, as it is by far the most desirable business that can be secured. In cases where there would be a possibility of the charging being done over the peak, a clause could be inserted in the contract whereby a penalty would be attached for using power during certain hours, which could be made large enough so that no customer could afford to take the risk of being caught violating this contract.

I understand that nearly all of the Edison companies and many other Eastern companies are pushing the vehicle business to the front. Many of them have large garages for the care of their own machines and have discarded horse drawn vehicles entirely, doing their heavy trucking as well as making their business calls by the use of electrics. In this way they not only set an example to the public but find that they save money, aside from the advertising feature which is secured by the use of such up-to-date business methods.

The operation of a modern central station in connection with its necessary distributing business requires many vehicles of different classes, from the light runabout to the 5-ton truck, and the central station should be the first to discard horses and thus hasten the day when electricity will be the only source of power used for all city transportation.

[1] Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2] Sacramento.

THE ELECTRIC VEHICLE MOTOR.[1]

BY J. T. DEREMER.[2]

We have all, I am sure, listened with interest to the excellent and instructive papers which have been read here today, and we have also learned much from the many points of view brought out in the various and able discussions which have followed these papers. So clear and evident have been these arguments made during the course of the day's progress that we have doubtless each firmly resolved to immediately begin the manufacture of mercury arc rectifiers and storage batteries, or at once promote a central station industry.

And so, I shall feel only complimented, if, by inflicting upon you here at the close of the day this seemingly technical paper on the electric vehicle motor—the last link to be put into our equipment—the one which produces *motion*—can I feel other than complimented if I now succeed in creating within you a desire for motion, which desire shall move you all from the room perhaps before I have finished.

However, I shall proceed with my paper hoping that the desire to follow our machine through to a completion will concentrate sufficient attention to the points which I wish to lay before you. For surely the vehicle without its motor is far from complete.

The motor equipment of an electric vehicle consists of the following:

One—One or two motors, according to the requirements of the vehicle.

Two—The controller complete with cable tips.

Three—The main switch with cable terminals.

Four—The charging receptacle with plug and cable.

Five—The battery contacts with cable terminals.

Six—The wire and necessary wiring diagrams.

With these parts properly selected, any one familiar with ordinary vehicle construction can build electric vehicles also.

Of these parts we shall here consider only the motor, its controller, and their connection to each other.

Let us first look into the advantage inherent in an electric motor for this use. As has been said earlier in the day the electric vehicle is not in its present stage of development adaptable to all purposes for which other types of cars have proven so successful, but in its own particular field of operation, namely, the city suburban duty, it has advantages over all others, and of these advantages the following stand out conspicuously as due to the motor.

Its operation is noiseless; due to the absence of reciprocating parts, it is free from vibration—it is cleanly and free from odor—it is very simple in construction and suspension, thus permitting of easy and rapid repairs or replacement, and its maintenance and up-keep are comparatively negligible. Other distinct advantages will be brought out during the course of the description of the motor construction.

Before going into an analytical study of the motor, let us for a moment look into the requirements of a vehicle motor.

The motor best suited to this service combines those features which will give sufficient strength, together with the best average speed, efficiency and high torque values in proportion to the current consumed. Unlike motors for all other classes of work, it can have no protective devices, such as circuit breakers, or wires that will fuse and open the circuit when an excess of current passes. Such protection is impracticable, because when an excessive demand for power is made by the motor of an electric vehicle it is at a critical point in its operation, as on a heavy grade, a bad place to start, or a condition when above all other times power is wanted most and must be relied upon. The motor, therefore, must be designed and constructed to withstand all the power that can be applied to it in the propulsion of the vehicle for which it is built. Further, automobiles are frequently driven by persons who have but little idea of what a machine should be able to stand, and who, therefore, use poor judgement in operating them. Motors which cannot undergo the abuses of such service without injury are not practicable. In still another respect an automobile motor must possess exceptional qualities—it must combine strength and lightness, so as to insure good operation amid all the jolting and vibration of travel, with the fewest possible repairs. A properly designed motor, for use in connection with storage batteries, must possess a well sustained efficiency curve at overloads, and still retain its good speed and torque characteristics, throughout its range of operation. The amount of iron and copper used must not be stinted, although generous proportions in this respect may add somewhat to the weight of the motor, this increase is more than counterbalanced by the resulting improvement in its operating characteristics.

Let us now look briefly into the construction of the motor, to see how the above requirements have been fulfilled.

The motor is built for two sets of speeds: the high speed motor for operation with a double reduction gear and the low speed motor with a single reduction gear. Where large output together with light weight are the essential requirements, the light weight, high speed motor, with the double reduction gear is preferable. On the other hand, where a greater weight is permissible and long life of wearing parts is a feature, the heavier weight low speed motor, with the single reduction gear should be used.

We shall treat the construction of the motor under two heads:

The Mechanical Construction.

The frame of the motor is built in cylindrical form. This is in order to get the greatest output from the least quantity of material. The frame is entirely enclosed and solid, that is, made in one piece. The armature is removed by taking off one of the end brackets. The motor is made waterproof, which is a valuable feature when the madam's garden hose is turned on the machine to remove the mud accumulated during the recent rain. The armature and commutator of the motor are built up on one sleeve, and the shaft pressed into this sleeve, so that if the shaft of the motor becomes sprung through careless operation or very rough usage, the same can be readily removed and another put in.

The oiling system is the same as employed in street railway motors, that is, the well known type of wiper or waste packed bearings. The motor is suspended by four stud bolts at each end and is thus easily removable for replacement or repairs when necessary.

The Electrical Feature.

The automobile motor is of the direct current series type, and has operating characteristics similar to the well known street car motor. Other types have been tried, such as compound wound motors and also shunt wound motors, but none of these possess in the same degree the valuable characteristic of automatically adjusting the consumption of power, as it were, to the load, that is, as the load increases the speed decreases, thus lengthening the time of operation and hence decreasing the power necessary to produce a definite torque. The efficiency of the motor is maintained fairly high throughout its range of operation.

Just here let me call your attention to a feature especially characteristic of the electric motor, as compared with other forms of vehicle motors.

As is well known, a railway type motor is rated intermittently, that is, the nominal capacity of the motor, is that capacity at which it can operate for one hour with a temperature rise not to exceed a given amount. This method of rating has been found best adapted to work, such as the operation of street railway cars requires, because on an average city line the motor is working only a few moments at a time, due to the many stops and inclines, and hence has an opportunity to cool down during the intervals when current is not applied.

Obviously, a motor suitable for continuous operation, developing the same horse power as a regular street car motor oper-

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Westinghouse Electric and Mfg. Co., San Francisco.

ating intermittently, would have to be very much more liberally rated in order that the heat generated internally could be radiated sufficiently fast to prevent an injurious rise of temperature.

Now the same principles apply to automobile operation. That is, a motor in city truck service, as well as pleasure vehicle operation, is subject to only intermittent operation, and consequently the motor can be rated much more closely than could a motor for continuous operation.

It has been found that for continuous operation, the demand on the motor must not exceed sixty per cent of the one hour rating. The point I wish to emphasize in this connection is as follows:

By reference to the performance curves of the series automobile motor, it is found that the efficiency of the motor is highest when operating at approximately 60 per cent of the nominal rating, hence, if continuous operation is necessary, the maximum permissible output which can be taken from the motor will be obtained with the motor operating at its highest efficiency. You can easily see that this is a very valuable feature.

The Controller.

Let us now take up the controller and its connection to the motor, in order that we may ultimately bring out other points of advantage in the complete electric equipment.

The controllers for vehicle motors are made in such a form that they may be set in the seat of the vehicle where they are easily accessible from the top and the front. The controller is of the familiar drum type, with sliding contacts and fingers which press against the contacts. The reverse drum is a part of the controller and is operated by the main control lever, or by a heel press at the bottom of the vehicle. The main drum and the reverse drum are made interlocking, so that it is impossible to reverse the motor with the controller handle in any but the off position. In this position the main drum is locked unless the reverse drum is exactly in the forward or reverse position.

The operation of the controller serves to apply several successive electro-motive forces to the brushes of the motor armature and hence vary the speeds accordingly.

The method of control differs somewhat from that employed in street car service, in that no resistance is employed for controlling the voltage applied to the motors. The interconnecting of batteries and field coils, and motors, is so arranged that four speeds forward and from one to four speeds reversed operation are obtainable.

This type for control for automobiles is of two kinds. First, that in which the battery connections are changed as well as the motor connections. This plan is employed usually where only one motor is used, or where it is essential to make the work required of the battery as easy as possible. The second type of control changes only the motor connections, the battery cells always remaining in series. This plan is employed where two motors are used, as it is here possible to obtain a greater number of combinations than in the case of a one motor equipment.

If you will bear in mind that the fields of each motor are separated into two equal groups, and that the battery is arranged into two equal groups of cells, the following brief statements of the motor control will be easily understood:

FIRST NOTCH—

Field groups in series.
Battery groups in parallel.

(This applies the lowest obtainable electro-motive force to the brushes.)

SECOND NOTCH—

Field groups in parallel.
Battery groups in parallel.

(This applies a higher electro-motive-force to the brushes, because the total voltage drop across the field is reduced.)

THIRD NOTCH—

Field groups in series.
Battery groups in series.

(This applies a still higher electro-motive-force to the brushes.)

FOURTH NOTCH—

Field groups in parallel.
Battery groups in series.

(This impresses the highest obtainable electro-motive force upon the brushes.)

In the two motor equipment the fields as before are in two groups, but the battery is always in one group. The connections are made here as follows:

FIRST NOTCH—

Field groups in series.
Armatures in series.

SECOND NOTCH—

Field groups in parallel.
Armatures in series.

THIRD NOTCH—

Field groups in series.
Armatures in parallel.

FOURTH NOTCH—

Field groups in parallel.
Armatures in parallel.

You will note in the above description of speed control, which possibly sounds somewhat complicated, and yet in reality is extremely simple, that there is an entire absence of mechanical complications such as is necessary in other types of cars, the motor being in every instance, connected rigidly to the driving wheels, and the entire control of the machine reduced to the simple electrical control of the motor. This fact brings to mind two very important advantages of the electric driven machine, namely, in addition to the regular band brake equipment of the automobile, an emergency brake can be arranged on the end of the motor shaft, and since the motor is always in direct communication with the driving wheels, this will prove an additional factor of safety. There is further a possibility of using the electric motor as a generator for braking purposes, thus eliminating brake friction and the strains incident to brake application. The motor is turned into a brake or generator by simply reversing its armature connections and connecting the armature leads across a resistance.

The above plan, however, is very sensitive to the speed at which the car is moving at the time the application is made, being very light at low speed and very heavy and effective at high speed. The better plan is to place the fields in series with each other and with a small hand operated resistance across a few cells of the battery. Then by closing the armature circuit the amount of braking effect can be regulated by the resistance handle, and the braking as in the case of a long hill made as effective as desired.

It is almost superfluous to add that the up-keep of the electric motor and controller is scarcely to be considered seriously. Of course, the bearings and brushes need occasional looking after, but as in street car service the brushes frequently run for months without renewal and bearings only need their proper supply of oil. The attention given any ordinary piece of machinery will, of course, keep the bolts tight and the lids and the hand-holes covered, which is more vital in the case of the motor, owing to the necessity of excluding of moisture. There must be an occasional renewal of pinions and bearings, but taking the subject as a whole the cost of maintenance of the electric motor equipment is very slight.

Summing up the situation then—as a power, the electric motor is incontestably a most suitable medium for automobile work, by reason of its being practically perfectly safe, its capacity for direct application, its high ratio of efficiency and the facility by which it can be controlled. Not only does the electric motor automatically control the consumption of energy, both with light and heavy loads, in proportion to the power delivered, but it will also work should occasion arise, with an overload of several hundred per cent for brief periods of time without any appreciable inconvenience.

THE ELECTRIC COMMERCIAL VEHICLE.[1]

BY A. C. DOWNING.[2]

The electric commercial vehicle, its development, field of action and sale is the direct subject of this article. But to place the matter clearly before you decided it advisable to discuss in a general way the whole field of commercial vehicles first, then specialize.

You as central station managers, superintendents, or automobile dealers, as the case may be, naturally are the best mediums through which results can be accomplished. The development of the field for electric machines is a point of vital interest to us all. Many never having had an opportunity to come in direct contact with any prospective purchasers will relate some of my experiences and arguments. In this way I believe you will be able to grasp the situation more readily and profit thereby. The discussion following the paper will enable you to ask such questions, or make suggestions as may arise in your minds.

Arrangements are made for demonstrations over the various routes and then comes the real struggle. All the drivers imagine their jobs are in jeopardy, besides the horses have become part of their lives, hence arise jealousies and skeptical opinions. Many of them are "kill joys" of the first water. In most every instance while your truck is waiting for a load there will be other drivers congregate and a conversation similar to the following takes place:

> "I'll bet you, Bill, she won't go my route. You get her out on West Seventy-second street, between Clark Brown, when I have that pound of tea for Mrs. Jones. Twenty to one I'd be phoning for them to send me 'Bess and Bill to the little red wagon.'"
>
> James cheerfully speaks up: "They 'ought to' send that 'artermobile' on my Johnsville route, specially after a big rain. The odds are against her ever coming back." etc., etc.

One morning when demonstrating in Portland, while one of those mists that "don't wet you" "happened" to be falling, I was waiting in front of a residence on Willamette Heights when,

Studebaker Electric Baggage Truck.

presumably, the owner of the home and his wife came out to take a street car. In passing the wife said, "That is one of those little electrics. I do hope they will become more general in service as I hate to see the poor horses tire themselves out climbing these hills." Mr. Husband, with stern voice, said, "They are all right on the level but they won't last long on the hills," and with that stepped up closer to the machine and asked what make it was, and as to what experience I had had in negotiating the local hills. I replied the car was a Studebaker and that we had been doing excellent work over Willamette and Portland Heights, obtaining exceedingly good mileage. The wife spoke up saying she was glad to learn such was the case. The husband remarked to her, "Dear, the mileage of electrics will never hold up on hills as such a thing would be 'diametrically' opposed to the law of physics." Just at that moment the car came along. I have been looking for that man ever since to ask him if he remembered that it did not require any power when going down grade, also that by climbing hills on intermediate speed, the current consumption was some less than on high, thus gaining an efficient discharge from the battery.

Transportation of merchandise is an expensive part of a business, especially in large cities where there is congested traffic and high labor. A solution will be the self-propelled vehicle, thus occupying less room in the streets, getting away from railroad sheds and docks in better time, and one commercial vehicle driver being able to move two tons in the same time necessary to move one ton with horses.

Street conditions play an important part in the successful operation of automobile trucks. Hence the more rapidly streets are improved, the quicker auto trucks will come into general use.

When approaching firms regarding making investigation and considering the use of commercial vehicles, I find the owners, or managers, are always willing to give the matter due consideration. The superintendent of the delivery system, and stable "boss" are called in to give such data as may be desired. They gladly enter into the spirit of the matter, appreciating fully the value of an up-to-date delivery system.

[1] Paper read at first annual convention Pacific Coast Electric Vehicle Association.
[2] Pacific Coast Sales Engineer Studebaker Automobile Co.

Limitations.

Generally speaking this is a world of limitation. Every day produces more specialties, each object having its own function to perform. The doctor actively engaged in his profession cannot practice law, the brewmaster cannot sell ribbons, the gas maker cannot produce chocolate creams, the watchmaker cannot install a 5,000 h. p. turbine and generator, hack saws won't do for the production of a masterpiece oil painting, a ferry boat cannot compete with the Lusitania on the seas. So it is with the self-propelled vehicle against that of the horse-drawn type, both have their limitations and adaptibilities to their particular type of service.

Conditions must be considered. In negotiating the mountain paths of South America how long would the large Percheron horse last as compared with their mountain burro? In Venice what chance would a team of horses have as compared to the gondola or what kind of a show would the little Jap with a jinrikisha have against the taxicab for service in New York City. Such comparisons have about as sensible a sound as have some of the arguments put up against the commercial vehicle.

Labor saving devices are sold only after the public have been educated. We can all remember our first visit to a store, one part equipped with a cash box carried on an overhead wire, and the other part where the poor saleslady was continually ruining her voice calling for "cash." Many other such comparisons can be made.

In one instance my patience was tried to the breaking point, as one of the delivery boys was talking so boisterously, and boastingly, against the machine. I called the manager of the delivery system and asked him to give me that boy's route the next day. He did and naturally the boy hunted all the bad places possible. In spite of them we covered the route in exactly half the time usually consumed with his horses, and as a consequence the young man had to make another trip the same morning. Afterwards when the automobile delivery wagon drove up he was the first around and more than interested in how everything was going. He called me to one side saying, "I wish you would speak to the boss about me if they buy any of these machines, as I would like to drive one." This story is an illustration of what obstacles have to be overcome.

Types of Self-Propelled Commercial Vehicles.

Steam, gasoline and electricity are the most used sources of power. The steam type has not been developed to the extent in this country that it has in Germany and England. At the New York Automobile show just closed there were twenty-two concerns represented as manufacturing the electric and gasoline commercial vehicles. This will give the layman a fair idea as to the magnitude of the business.

Electric trucks have been successfully operated longer than any other type. At present there are many machines five and six years old giving as good service as when first installed. The Weidemann Brewing Company of Cincinnati, Ohio, which is a very hilly city, have six electric machines that have been in operation since 1903. Today they are giving the same service as when new.

The Anheuser-Busch Brewing Association have had fifteen of the three and five ton capacity electric trucks in operation since 1903. The depreciation on them has been very small. At present their commercial department consists of fifty-six electric trucks, varying from one and one-half tons to five tons capacity, and four machines of the gasoline type for extremely long runs.

The Adams Express Company have been, and are using electrically propelled vehicles exclusively in Washington, D. C.; Indianapolis and New Haven, Conn. They are using partial equipment in New York City, Chicago, Philadelphia and Rochester, New York.

The American Express Company are also using them in most of the largest Eastern cities.

The Los Angeles and Redondo Electric Railway Company are operating some fifteen electric trucks in Los Angeles. These vehicles represent practically all the heavy commercial vehicles used in any quantity by one concern on the Pacific Coast.

There are, of course, numerous gasoline light delivery wagons of 100 or 200 pounds capacity but are really pleasure vehicles with commercial bodies, so cannot be counted in the commercial vehicle class.

The above concerns represent classes of business having large delivery systems that must be in operation every day. They are conservative firms and have made extensive tests, minute investigation, only purchasing electrics after having been convinced of their reliability.

Failures.

There are always two sides to any question. There have been failures with electric vehicles—not so much failure of the machine, but owing to the lack of proper attention, and intelligent application. Trucks not being properly applied, and men in charge and operators not having had sufficient instructions as to care and operation from the makers. Often a five ton truck has been sold where the load occasionally amounted to that much. The three ton vehicle would have worked more successfully, making better time and entailing a smaller investment, and a much less cost of upkeep. Manufacturers in many instances have been responsible for such failures and mistakes. In several instances on the Coast the cars were sold, money paid, the representative left for the East immediately, and all responsibility shifted. Such practices have discredited the business, making it hard for a firm with good intentions to live it down.

Another tributary feature to the failure has been a mistaken idea many have had regarding giving automobiles attention. No piece of machinery is called upon to do so much work, with so little attention, as the automobile. This has been particularly true with commercial vehicles. I have known personally, in three instances, of an automobile truck running for five months without the wheel bearings even looked at. Would anyone treat a horse-drawn wagon in that way? The best part of it was the bearings were not injured; thus clearly demonstrating life a self-propelled vehicle would have, if given proper attention.

Application.

For long distance or interurban work the gasoline machine would be the most suitable. For city and surburban purposes the electric will prove more economical and satisfactory. Following are a number of reasons for my making this last statement:

First:—Their speed is within the scope of the law and the bounds of safety. A loaded car propelled at too high rate of speed is a menace to public safety.

Second:—If heavy loads are carried at greater speed than seven to twelve miles per hour, over the ordinary street one finds in the wholesale and shipping districts of a city, the strain and shocks on the wearing parts will incur more cost of upkeep than will be saved by quicker delivery. Engineers' tests have often proven this.

Third:—Being free from so many small mechanical moving parts insures reliability.

Fourth:—Simplicity of control permits an electric truck being handled successfully by regular horse drivers.

Fifth:—The motors employed are of the series type, like those of the street car. They are built to stand extreme overloads for an instant. Most everyone knows electric motors have long life entailing very small cost of upkeep.

Sixth:—The storage battery in its present stage of development represents a certain number of cycles (that is charges and discharges), thus making it possible to figure, with a degree of accuracy, the number of miles obtainable during the life of the plates. With this data at hand the cost of operation can be easily determined.

Seventh:—Continuous torque controllers eliminates all chances for arcing and "freezing." It is very seldom any trouble arises from the controller outside of the ordinary wear and tear.

Eighth:—Batteries and motors being hung underneath the framework, permits any body design desired. Also permits equal distribution of load over the rear and front wheels.

Ninth:—This equal distribution of weight saves tire expense, particularly on the rear wheels where the tires have to withstand the tractive friction, as well as the weight of the load.

Tenth:—Accessibility to all parts means simplicity in repairing and garage care. For instance if the crank shaft bearing of a gasoline truck should burn or wear out, the replacing of that bearing within itself does not consume one-fifth the time that is required to dismantle an engine and re-assemble. Putting in an engine for immediate service cannot be considered on account of the many connections to the carburetor, pump, radiator, fan, gasoline tank, exhaust pipe, magneto, batteries, transmission, and truing up in proper position on the frame. The same would be more or less true in event the transmission, or differential, were injured.

On the other hand with an electric truck the controller is independent mechanically of any other part. By loosening the wire terminals it can be removed and another one replaced easily within an hour. In five years association with electric commercial vehicles I have never found it necessary to pull out a controller provided the machines have had any kind of treatment whatsoever.

Batteries can be exchanged by two men in fifteen minutes.

Should an armature need attention, or become necessary to replace the motor complete, the change can be made within an hour and a half. Of course the repairing of axle, bearings, frame, body, or wheel, would remain constant with either gasoline or electric vehicles.

Summing up this tenth item means an equipment of say ten gasoline machines would require two or three extra machines to keep up the daily service, while one extra will do for an equipment of thirty electric machines. This point is not a guess or theory but a statement of results after quite a few years of actual work with machines in various classes of service in widely different cities.

Eleventh:—The keeping of electric machines in any building does not affect insurance but gasoline trucks will raise the rate to a point almost prohibitive.

Twelfth:—In a private garage where a number of gasoline trucks are cared for, every man must be a high grade mechanic, outside of washers and day laborers.

When caring for electric trucks, so much high grade help is not necessary. One each, experienced, well posted battery and motor man can successfully handle several trucks. If additional help is desired most anyone can wash, clean and reburn batteries, with very little experience. The motors and electrical parts have never caused enough work, in installations even the size of Anheuser-Busch, to keep one electrician busy all the time.

General Tendencies.

The improved streets and increasing size of cities are working greater hardships on the horses. In the wholesale districts just watch the poor beasts trudging along doing their very best for the master, but what is the result? The hard surfaced road stoves him up, the rains, snow and heat all produce ill results. These points are not drummed-up fancies—just read what active steps are taken by the humane societies. Very rigid laws are outlined and enforced. The maintenance and enforcement of such laws cost the cities dollars each year.

With the automobile, the hard surfaced streets exactly fill the bill. The elements don't affect them in any way, and who cares if a piece of machinery is abused, outside of the owner.

The sanitary features are worthy of mention. The cost of cleaning the streets of New York City is much less particularly around the hack stands and vehicle waiting lines in the shopping districts.

With the saving of time and labor which really is money, the electric commercial automobile will become more commonly used, but this time can be hastened if those interested in electricity will inform themselves more on the electric auto subject and in turn impart such information to others. Creating a demand must come before consumption.

THE ELECTRIC GARAGE.[1]

BY S. P. REED.[2]

The maintenance of an electric garage is an absolute necessity in every locality where electrics are sold and used. This is true both from the standpoint of the owner and dealer.

Here is a common story. A man is taken out for a trial trip. As he nears home he expresses his entire approval and says he believes he understands how to operate the machine, and to read the meter. He asks the dealer to give the wife and daughter a trial spin. They, too, are enthusiastic, but the deal falls through in the end, not because they are not all anxious and willing to buy the machine, but the man discovers that he will have to charge and care for his own machine. He is wise enough to know that he has no training and the undertaking would prove a failure.

A gentleman in Palo Alto bought an electric for his daughter. He had a fine home garage fitted up and all went so well that he often took the electric to his office in preference to his gasoline car, as it was so much easier to start in the morning, but soon the charging plant developed difficulties, the car was left discharged for a long time, bringing on battery trouble and eventually the outfit was discarded.

Last year a Menlo Park resident bought an elegant coupe with a complete charging outfit and numerous instruction books, but as there was no one to properly interpret the instructions this outfit, too, was discarded.

Case after case might be cited, all going to prove that the dealer must have a garage in connection with the sales room, and not encourage the owner in the idea that he can take entire care of his machine. The average owner might charge his own car but when the difficulties arise, which are sure to come to the amateur, he ought to rely on a competent garage man.

Electric vehicles must not be sold where the owners cannot be in close touch with the electric garage. A man familiar with his own occupation, and having his time taken up with it cannot be expected to take up a new occupation and succeed with it, and this is what a dealer asks of his customer when he turns him over an electric with a charging plant and considers the deal closed. Usually all goes well for a short time, and the purchaser is enthusiastic. His friends and neighbors watch the new machine with interest and envy, but soon troubles arise which the unskilled owner cannot remedy—troubles which to the expert, were he near, would be little or nothing. Generally they develop into enormities and the electric is classed as a failure by the owner and his friends. This idea is spread in the vicinity and the sale of electrics is often held back in many fields that would be the best with the electric garage to rely upon for assistance.

The electric garage is really a school to teach people the pleasure and benefits of the electrics and to show them how small the troubles really are.

The electric garage is equally a benefit to the owners and the electric vehicle trade. It gives to one a perfect transportation and to the dealer a profitable and satisfactory vocation. The profits are not only from the first sale but from the operation of the garage. The business, especially on the Pacific Coast, has no dull season, electrics being used winter and summer. The electric is the cleanest vehicle made, and the garage is a clean, quiet place. The patrons as a rule are the better element in the vicinity, people who prefer quiet and cleanliness, and who are in good enough circumstances to meet their obligations promptly. With a good system and proper equipment the business is an ideal one.

The location of the garage is an important item. In the largest cities there will be garages in both residential and business districts. In the average town the garage will be half way between the business section and the residential. The reason for this is easily understood when we consider that the electric is pre-eminently the family car and is fast becoming the most

[1]Paper read at first annual convention Pacific Coast Electric Vehicle Association.

[2]Reed Electric Laboratory, San Jose.

popular machine in this particular field. Each and every member of the family can run the machine for themselves, so these same people must have the garage in a place where all may visit it. It should be on an open street with no street car lines and little traffic.

The chief attraction of the electric garage must be its cleanliness. The machine, itself, is clean and its home must correspond. There is no objection to the electric being housed in the vicinity of the most fastidious people. There is no noise, no deafening gasoline explosions, no oil smoke and no greasy floors with the usual expectations of fire.

True the electric will be delivered where wanted, but as many times as delievered it will be called for by members of the family who will meet friends at the garage, and this brings more customers.

The plans of every garage should include a well planned reception room for ladies and gentlemen, with especial accommodations for ladies. There have been, up to the present time, very inadequate accommodations at garages and there should be more attention paid to this feature. The ideal reception room will be near the door, not having the interior visible from the street, but it would be well to have glass doors on the show-room side.

The garage, if there is sufficient street space, ought to have an entrance and an exit—entrance on the right and exit on the left. This avoids confusion.

The show room might well be on the exit side. This for many reasons. When the machines come in they are often muddy and not as presentable as they might be.

The wash-room should be as near the door as possible. This saves the floor and prepares the machine for any repairs it may need. If there is no repair it can go at once to its stall in the charging or store room.

The charging room occupies the greatest amount of floor space in the garage. There will be no work done on the car in this room;; the wash room, tire room, battery room and repair shop being seperate rooms.

When a car is to be kept in a garage it is well to give it a number. This number should be used on every tag attached to the machine, on the charging stall, charging plug, owner's locker, in fact every thing pertaining to that particular car.

There are two approved methods of charging electric vehicles. One might be termed the central or collective, the other the individual.

In the central the readings are all taken at one central station, where is located the generating plant, the switchboard recording files and rheostats controlling the current to each machine. The instruments should consist of one voltmeter and two ammeters, one ammeter showing the total current, the other showing the individual current, having the bus-bars so arranged that the readings may be taken from any machine on charging. The only readings that cannot be taken here are the acid gravities and the voltages of the separate cells.

In the individual method the rheostats are placed back of each separate machine and the readings usually taken from the machine meter, though the current may be read from the main switchboard. Both systems have their merits. In both a careful tag system is universally used. On these tags is printed the records for each car. These records must be in detail, not only charging records are made but also records of repairs and performance. These records can be tabulated to prove the success of the electric vehicle and to prevent misunder-standings of accounts and so perform one of the most important details of the garage work.

The source of the power varies in different localities. There is nearly always a local power plant anxious to serve the electric garage especially if an agreement can be made whereby the garage used most of its current away from the peak of the community's load. This is naturally the time when the garage needs most of its current. The price, for this reason, ought to be less to the garage than to any other consumer. If direct current is supplied, a switchboard with regular rheostats is all that is needed. If the current is alternating, some method of transforming to direct is necessary. For the large loads or periods of large loads a motor generator set is best. For smaller loads the mercury arc rectifier is preferable.

In the isolated places the garage may generate its own current, there being on the market at the present time many reliable gasoline generating plants.

There should be rolling tables to take the batteries to the battery room, as it is not a good idea to take the machine where the paint, iron and upholstering will be subjected to the acid fumes.

The battery room as well as the charging room must be in charge of trained and competent men. These men, in fact, must be experts, as they are the main-stay of the electrical garage. The number of men required for each garage is said to be one expert for every 25 machines and one boy for delivering, to every 15 machines. There will, of course, be a day and night washer, machinist and a good manager. This with a book-keeper ought to complete the pay roll.

The other expenses in the garage will be the rent, insurance and power. The rent averages about $2 per month per machine and the current costs from $5 to $7 per month per machine. The help on the machine is not more than $6 per month. Owners, as a rule, carry their own insurance.

The receipts for charging and storing averages $25 per month. Repairs and sundries are extra. Adding to these sources of income, the profits on sales of new machines, a neat balance can be figured for the garage owner.

The electric garage deserves friends on all sides. The electric vehicle and storage battery manufacturers should show it every encouragement, for it is their chief outlet for their products. Every central station man loses his best load when he neglects it, and finally, let the people welcome it as it brings them the electric vehicle.

ELECTRIC AUTOMOBILES AND SURGERY.

Dr. H. Threlkeld-Edwards, director of St. Luke's hospital, South Bethlehem, Pa., is a gentleman of high professional attainments and many-sided culture, but among his different interests there are two that call out his keenest enthusiasm. One is his perfectly equipped X-ray laboratory, in which he applies clinically the discovery of the famous Roentgen to the great variety of surgical and medical cases that are constantly being treated at his hospital.

Another of the doctor's enthusiasms is the use for pleasure and professional duty of his Waverley electric automobile, in the care and handling of which he is an expert. What more natural then than that he should seek to connect these two pet hobbies of his by employing the storage battery of his electric for operating his X-ray instruments?

The suggestion is obvious enough, now that you read it, but who else besides an X-ray specialist and electrical expert would have thought of it? The doctor not only thought of it, he put it into immediate execution, and the results were fully up to his expectations. Here is his latest letter on the subject:

"Since last writing I have tried out the plan and am putting it in daily operation. It works perfectly, and its simplicity and 'can't go weary' properties make it most available for general adoption. I am quite confident that I can develop this idea into a most valuable asset for the Waverley Company, at the same time confer a still greater benefit on the medical profession in thus opening their eyes to a plan whereby they can secure an automobile capable of running up hills and through mud (I do it every day, for this is a very hilly locality), at a cost of current consumption of about $5 per month (my December bill was $3.80), and at the same time secure an X-ray plant by an additional outlay of less than $150 that will do the work of a coil and rectifier, etc., costing over $500, and be able to take the apparatus wherever the car will go. My total outlay for X-ray attachment is less than $130, including coil, condenser, interrupter, Mueller tube, stand and leads. I paid $750 for my office outfit running by short (alternating) current."

Now when you consider that this means providing an ever ready portable X-ray outfit for the up-to-date physician and surgeon at a cost of less than $150, it seems that the doctor has made a valuable discovery for the profession, and that one very great advantage of the electric vehicle for medical use has been demonstrated beyond peradventure.

CURRENT COMMENT

Carbide of tungsten as a solder for connecting incandescent lamp filaments to their supply wires has been recently patented by an Austrian inventor, Hans Kuzel, of Baden, near Vienna.

Long transmission of small power is necessary to supply the copper mines near Chilecito, Argentine, with electric power. A transmission plant has been built to carry 100 h. p. twenty miles because of the scarcity of fuel.

Butter by electrolyzing cream is a process recently patented by two Ohio inventors. Butter globules mass on a positive electrode suspended in cold cream, the current also having the necessary "ripening effect." The butter collected is aftewards worked into squares or rolls.

A praying car is to be provided for devout Mussulmen traveling to Mecca on the Hedjaz railway in Turkey. The car exterior is ornamented with a minaret 6½ feet high and the interior walls contain verses from the Koran and a chart indicating the direction of Mecca. A rich Persian rug is on the floor and four vessels of water are provided for ablutions.

An automobile as an electric power plant was recently put into service at the Vanderbilt Cup race. It was necessary to light the grounds with electric light and as no connections could be made with central station service, an automobile was mounted and attached by belt to a dynamo to furnish the current for fifty-five incandescent lamps of 110 volts, 16 candle power.

Low expansion metal has been discovered in 36% nickel steel. The expansion of this alloy is not greater than that of melted quartz and seventeen times less than that of steel. By varying the proportion an alloy can be obtained with the same expansion of glass, thus displacing platinum in incandescent lamps. It is non-magnetic and inoxidable. "Invar" is the trade name.

Silicon resembles carbon in being a poor conductor of electricity, and in having a negative temperature coefficient in resistance. It is thermoelectrically negative with respect to copper. At the mean temperature of 20° C. the thermoelectric power of a lead-silicon couple is —400 microvolts per degree. Under the same conditions a bismuth-lead couple gives —89 microvolts and an antimony-lead couple +26.

No automobile contests are to be entered by thirteen of the largest automobile works of Germany and France, who have come to an agreement not to participate in any big race or competitive contest during 1909. The penalty for violating the agreement is fixed at $20,000. This move is apt to put a damper on the speculation in constructing auto roads for racing purposes. The competitive races have caused heavy expenses to the automobile manufacturing works.

Tantalum has a melting point between 2,250 and 2,300° C. Its resistance increases with rise of temperature. At ordinary temperature the resistance of a wire one meter long and one square millimeter in section is 0.165 ohm. At the temperature of the incandescent lamp this figure becomes 0.85 ohm. The breaking strength of tantalum, when cold, is very great, being 93 kilos per square millimeter, as compared with from 70 to 80 kilos, for good steel. When heated, however, it becomes soft like osmium, and a filament, after burning for some time, is easily broken. The material is for incandescent filaments, the diameter being from 0.35 to 0.05 millimeter.

Telegraphing over power lines is described in L'Industrie Electrique by M. L. Neu, who uses a method of communication over high-pressure power lines by means of high-frequency currents, thus saving the expense of a separate telephone line. The principle is that of superposing a current of very high frequency upon the power currents, by means of a condenser, an inductance coil and a spark gap. The line pressure may be used to produce the sparks, or a small transformer, or a spark coil fed from a separate source. At the receiving end there is a spark-gap, in series with condensers and shunted by a relay, which may be used to close the circuit of a call bell. Communication is effected by Morse signals. Instead of using two line wires, one of them may be employed with earth return.

Electric crop forcing experiments are being conducted by Mr. J. H. Priestley, lecturer in botany at University College, Bristol, who has taken a great interest in studying the influence of electricity in increasing the yield of cereals, vegetables and fruits, and last year received through the college a grant from the Board of Agriculture to enable him to extend his investigations, according to the Electrical Engineer of London. As regards wheat, the results show that an electrified area of 7.675 acres yielded 249 bushels, 33 pounds, equal to 32.5 bushels per acre, while an unelectrified area of 10.2 acres yielded 26.4 bushels, 1 pounds, equal to only 26.15 per acre. As the current was not applied until May 17, this increase, which was due chiefly to the better filling out of the ears and plumper grain, was most satisfactory. The current, however, was applied too late to affect the number of ears. In the experiments with strawberries, it was proved that electricity brought about a great acceleration of the crops in the electrified area compared with the unelectrified area. On the first pickings there was 40 per cent more fruit gathered from the former. Through the dry season, and the tendency of electricity to increase the dryness, there was a slight falling off in the total yield of the electrified area compared with the other, but the fruit was very much sweeter, containing nearly twice the amount of sugar. In the experiment with tomatoes the yield from an electrified area was 30 per cent better than from the unelectrified area.

The Budapest news-telephone which has been in successful operation for several years past, is owned and managed by a private corporation, whereas the regular telephone system is owned by the government and administered by the ministry of posts and telegraphs. The annual subscription, $7.31, paid quarterly in advance, entitles the subscriber to two receivers and the full service of news, music, etc., the subscriber to pay the expense of installation and removal, generally about $8.50. The service begins at 8:55 a. m., when a buzzing noise, loud enough to be heard across a large room and lasting for fifteen seconds, announces the correct time. At 9:30 the day's programme of important events is announced; that is to say, the ceremonies, lectures, plays, races, etc. At 10 and 11 o'clock stock quotations and general news items are given. At noon comes a second announcement of the correct time, followed by parliamentary news and general items of interest. At 12:45 stock quotations from the local, Vienna, and Berlin exchanges and general news. At 2 o'clock more parliamentary and general news, and at 3 p. m. the closing prices of stocks, meteorological forecast, local personals and small items, and in winter the condition of the various skating places. At 4 p. m. court and miscellaneous news. From 4:30 to 6:30 military music from one of the great cafes or gardens. In the evening the subscriber may choose between the royal opera or one of the theaters, and later music by one of the orchestras. This programme is sufficiently varied to satisfy the desires of all classes of subscribers, and in general the service seems to give the utmost satisfaction.

JOURNAL OF ELECTRICITY
POWER AND GAS

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE

PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The discussion on papers read at the convention of the Pacific Coast Electric Vehicle Association will appear in our issue of March 6, 1909.

Low Rates For Vehicles

It was very evident at the convention of electric vehicle men held in San Francisco last week that few electric automobiles can be sold until lower rates for power are made by the central stations. The indifference of the central stations to the desirability of the electric automobile as a source of revenue is perhaps founded on prejudice. Their first impressions of a crude, imperfect machine, which like an unfledged bird is as yet untried, should not afterwards hinder its advancement, especially when it is a machine that has so greatly improved with time as has this. What with increased efficiency in running qualities and greater capacity of batteries, it is a far cry from the electric automobile of five years ago to that of today.

The electric car is distinctly a city machine, in direct contrast to the touring ability of the gasoline. The speed of the electric is greater than that ordinarily allowed by city regulations and its daily mileage capacity is in excess of the usual requirements for either business or pleasure. However, it is neither our intent nor our province to here advertise the electric carriage, but rather to demonstrate what a money-maker it may become for electric power companies.

A public garage, caring for thirty machines, has a current bill of from two hundred to three hundred dollars per month; home garages in proportion. An automobile uses more current for its storage batteries in one month than a cigar-lighter does in ten years. Furthermore, its current is consumed after midnight, off the peak, when costly apparatus would otherwise be idle while the interest on the investment piles up, water power runs to waste and depreciation continues. Here it is that the electric automobile does service as a grading machine in filling the "valleys" in the load curve. But little extra investment is required to supply the current needed. The demand is steady and it is permanent. The storage battery is probably the best automatic corrector of the load factor yet devised. It works while you sleep.

As the most desirable customer, the electric vehicle owner should also be the most favored, and as such entitled to a low rate for current. With a moderate current cost it is no more expensive to keep an electric car than a horse, and central station companies can do more good for themselves by encouraging the use of electric vehicles than in almost any other way. This encouragement may take several forms, including the use of commercial vehicles for trucking, and runabouts for collecting. But particularly may it be accomplished by lowering the power cost to a most beneficial consumer.

PERSONAL.

B. W. Traffort, vice president and general manager of the Bell Telephone Company's lines at Detroit, Michigan, is in San Francisco.

W. C. Bryant and Harvey Hubbell, accompanied by their wives, spent this week in San Francisco and are now in Southern California.

C. M. Clark, of Philadelphia, chairman of the executive committee of the Portland Railway, Light and Power Company, has been in Portland on his annual trip of inspection of the local properties of the company.

William Finn, of New York City, electrical expert for the Western Union Telegraph Company, reached San Francisco this week. Mr. Finn is making a study of the effects of high-tension transmission on telegraph lines.

C. G. Young, engineering and construction specialist of 60 Wall street, New York City, will be in the Philippine Islands, China, Japan and Siberia, from March until August, 1909. During Mr. Yonng's absence his office will be under the direction of his associate, J. N. H. Cornell.

L. B. Dixon, formerly with the telephone department of the Chicago office of the Western Electric Company, is in San Francisco with the intention of making his headquarters on the Coast, having resigned his position. Mr. Dixon is well known in the West because of his frequent trips here.

NORTHWESTERN CONSERVATION CONGRESS.

The first Conservation Congress for the Northwestern States will take place in Seattle on August 16-17-18. A call for the Congress has been issued by the Washington Conservation Association, one of the strongest State organizations in the country. Arrangements have been made for the entertainment of 1,000 delegates and the meetings will be held in the Auditorium on the grounds of the Alaska-Yukon-Pacific Exposition.

Through Acting Governor M. E. Hay the Governors of all the States will be asked to be in attendance at the Congress. Such men as Andrew Carnegie, Gifford Pinchot, Frederick Weyerhauser and others have already been extended invitations to participate in the Congress and according to C. H. Baily, Secretary of the Conservation Association, the convention will be the biggest thing of its kind ever held in the United States saving that of the Congress of Governors called by the President a year ago.

The Washington Conservation Association has engaged Aashel Curtis to go through the State and take a series of conservation photographs that, it is expected, will be second to none in the world. These will be exhibited in the exposition auditorium during the Congress. The views will include forestry, fisheries, irrigation and other phases of conservation work such as have heretofore never been assembled in the West.

Chambers of commerce, commercial clubs and other organizations in the State will be asked to name official delegations to attend the Congress, and through Lieutenant Governor Hay, the Governors of the States will be asked to name delegates.

The officers of the Conservation Association are: President, E. H. Libby, Clarkston and Spokane; Vice-Presidents, Joel Shomaker, Tukwila; Captain Everett G. Griggs, Tacoma; Oliver C. McGilvra, Seattle; Dr. N. G. Blalock, Walla Walla; I. A. Navarre, Wenatchee; Elmer E. Johnston, Everett; Secretary, C. H. Baily; Treasurer, Frederick Foster; Trustees, H. W. Carroll, Prof. Frank G. Miller, Walter N. Granger, W. W. Beck, L. G. Monroe.

ELECTRIC CLUB.

The regular weekly meeting of the Electric Club of California was held at noon, February 25, Hotel Argonaut, San Francisco. Dr. E. E. Baker of Cleveland, Ohio, gave a talk on the subject of Salesmanship, differentiating between the mere order-taker and the good salesman.

UNIFORMITY IN RATE CARDS.

The Technical Publicity Association, C. S. Redfield, advertising manager Yale & Towne Mfg. Co., President, has been asked by several leading trade papers for suggestions in the arrangement of their rate cards, with a view to putting these in a form most acceptable to the advertisers. In order to meet these requests, a committee has been appointed, consisting of the following: Messrs. Manfred, Snyder and Strong. The duties of this committee will be to propose a popular and uniform style of rate card and to recommend its nse to the publishers of the leading trade papers.

TRADE CATALOGUES.

Folder 4122 from the Westinghouse Electric and Manufacturing Company is devoted to Electric Suction Sweeping.

February Bulletin of the Ohio Brass Company of Mansfield, Ohio, contains a valuable article on "Bonding in Mines."

General Electric Company's Bulletin, No. 4643, illustrates and describes two lines of switchboard instruments for direct current.

Electric Motor Friction Brakes are described and illustrated in Circular No. 1158 for the Westinghouse Electric and Manufacturing Company.

Bulletin No. 5533 from the Western Electric Company illustrates and describes a system of series incandescent ilghting with tungsten lamps by means of automatic regulators.

The Duncan D. C. Integrating Wattmeter, House Type, Model E, is detailed by pictures and text in an interesting bulletin, No. 8, from the Duncan Electric Mfg. Co., Lafayette, Indiana.

Bulletin No. 23 from H. Krantz Manufacturing Company, of Brooklyn, N. Y., illustrates and describes in detail various types of high grade and commercial grade panel board switches and panel units.

Westinghouse Fan Motors for 1909 are attractively described in an artistic pamphlet, No. 1165, from the Westinghouse Electric and Manufacturing Company. The cover is one of the handsomest issued this year.

The General Electric Company has issued Bulletin No. 4644 which describes a motor generator set particularly suited for use in connection with searchlights, welding, for power work or as a reversible booster for battery service.

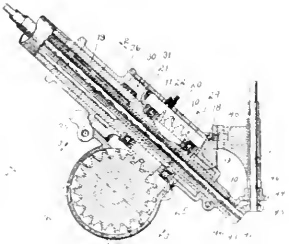
Mercury Rectifier Battery Charging Outfits are described in detail in Circular No. 1148 from the Westinghouse Electric and Manufacturing Company. It has been designed for automatic or non-automatic starting. Type A for automobile battery charging is illustrated and described in a separate leaflet.

In Bulletin No. 4641, just issued by the General Electric Company, are stated the advantages to be derived by the use of electricity in the lumber and wood working industries. The relative merits of alternating and direct current are briefly stated and a description is given of the plant of the Great Southern Lumber Company. The description includes numerous illustrations.

The General Electric Company has issued Bulletin No. 9640 devoted to large transformers, in which are given some of the more important points regarding the relative merits of the different types of large transformers manufactured by this company. This publication has to do with the oil cooled water cooled, and air blast transformers of large capacity, and contains illustrations of both the exterior and interior of various types.

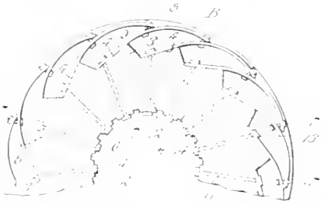
PATENTS

911,777. **Steering-head for Automobiles.** Harry C. Stutz, Indianapolis, Ind. In a steering head, the combination, with a worm wheel, a worm meshing therewith, and a shaft carrying said worm, of a pair of thrust bearings arranged at opposite ends of the worm to take the thrust thereof, one of said



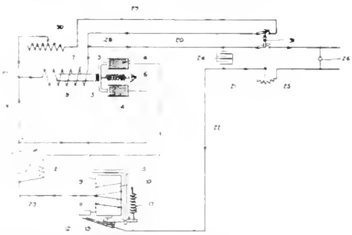
thrust bearings having one of its members threaded upon said shaft to serve as a retaining member for the worm, the direction of pitch of the threads being such that the thrust of the worm thereon will serve to tighten said retaining member on the worm, and abutments for said thrust bearings.

911,826. **Vehicle-Wheel.** Nathaniel G. Long, Elberton Ga. In a wheel, the combination of an annular body having a V-shaped groove, a plurality of springs rigidly secured at their ends to the bottom of the groove, and means for slidably



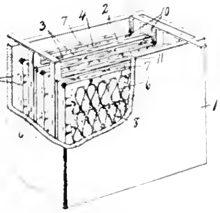
connecting the free ends of each spring to the intermediate portion of the adjacent spring, with a rubber tire extending around the body and bearing directly on the springs and entering the groove at opposite sides of the springs.

911,850. **Battery-Charging System.** William I Thomson, Newark, N. J., assignor to The Safety Car Heating and Lighting Company. In apparatus of the class described, in combination, a source of current, a secondary battery in circuit therewith, a current utilizing device adapted to be put in cir-



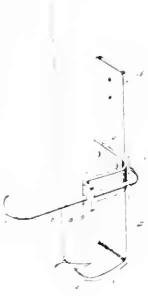
[illegible] means adapted to regulate the output of said source of current, said means comprising a solenoid, a shunt about said solenoid and a single means adapted substantially simultaneously to close the circuit of said shunt and throw said current utilizing device into circuit.

912,242. **Electric Storage Battery.** Henry K. Hess, Philadelphia, Pa., assignor of one-half to Thomas O. Peirce, Philadelphia, Pa. An electrode for storage bateries consisting of a substantially rectangular open frame composed of contacting lead strips secured together face to face, and a series of



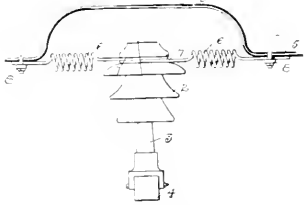
lead strips arranged in horizontal tiers, one above the other and having their ends interposed between the strips of the frame and their intermediate portions bent in the form of upright open loops.

912,123. **Pole-Climber.** Herman C. Hansen, Newcastle, Nebr. A pole climber comprising a supporting member having an upright approximately flat body, a brace of approximately right angular form attached to the inner face of the supporting member, with one portion thereof extending inwardly approximately at right angles therefrom, the outer



end of said inwardly projecting portion terminating in an outstanding apertured lug, a catch connected with the body of the supporting member and extending through the apertured lug of the brace, the inner end of the catch terminating in a hook portion adapted to receive a pole.

911,973. **Insulating High-Voltage Transmission-Lines.** Walter T. Goddard, Victor, N. Y., assignor to The Lock Insulator Manufacturing Company, Victor, N. Y. The combi-



nation with a high voltage transmission line and a support connected with the earth, of an insulator and high resistance interposed in series between the line wire and the support.

INDUSTRIAL

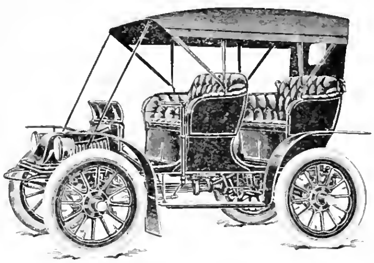
Babcock Runabout. Pacific Garage & Livery Company, San Francisco.

Battery—French, 100 miles.
Motor—High speed.
Speed—8 to 35 miles.
Upholstering—Leather.
Steering—Wheel.
Control—Foot lever.

Detroit Runabout, Model L. Western Electric Vehicle Company, Oakland, Cal.

Battery—16, 20 or 24 cells.
Wheels—Artillery type, 32".
Tires—3½" pneumatic.
Brakes—Motor and internally expanding hub plates.
Steering—Side lever or wheel.
Control—One lever.
Speed—8 to 21 miles per hour.
Mileage—60 to 80.
Weight—1700 pounds.
Upholstery—Leather.
Top—Cape.

Baker Surrey. Western Electric Vehicle Company, Oakland, Cal.

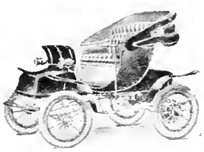


Battery—24 cells, 9 M. V. Exide.
Motor—Multiple, aluminum frame.
Drive—Side chain.
Wheels—Artillery, 30".
Tires—3½" front, 4" rear.
Upholstery—Cloth or leather.
Steering—Hinged side lever.
Control—Radial type.
Speed—5 to 20 miles per hour.
Body—Phaeton, top.

Rauch & Lang Stanhope. F. W. Pfaffman, Los Angeles, Cal.

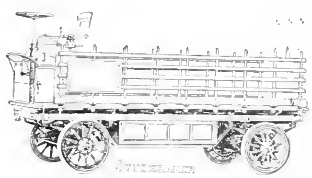
Battery—24 cells, 9 M. V. Exide.
Wheels—Artillery type, 32".
Tires—3½" Palmer web-pneumatic.
Brakes—Electric brake, motor brake and expanding hub.
Steering—Side lever.
Control—Continuous torque.
Speed—10 to 20 miles per hour.
Mileage—50 to 100 miles on normal speed.
Weight—1800 pounds.
Top—Hand-buffed enameled top, leather.

Columbus Victoria. Bay Cities Electric Company, Oakland, Cal.



Battery—28 cells, 9 M. V. Exide.
Motor—2½ h. p. 300% overload.
Drive—Shaft and bevel gear, silent chain reduction.
Wheels—Artillery, 36".
Tires—3½" front, 4" rear.
Upholstery—Broadcloth.
Steering—Side lever.
Mileage capacity — 40 on single charge.

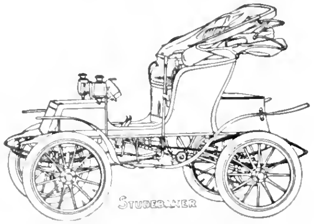
Studebaker Stake Truck. Studebaker Bros. Co., San Francisco.



Battery—44 cells, 19 plates.
Motors—Two (Westinghouse).
Wheels—36" in diameter.
Tires—6" single front, 4" dual rear.
Speed—7 miles per hour maximum.
Carrying space—Standard, 14' 6" long, 5' 6" wide.
Top—Any special design.
Capacity—10,000 pounds.

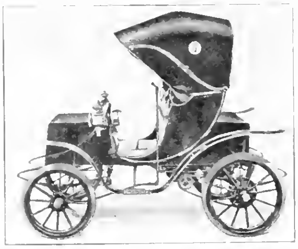
Cars Represented at Pacific Coast Electric Vehicle Association Convention at San Francisco February 19 and 20, 1909.

Studebaker Electric Doc'or's Coupe. Studebaker Bros. Co., San Francisco.



Battery—28 cells, 9 plates.
Motor—Single (Westinghouse).
Drive—Herringbone gear and roller chains.
Wheels—30" diameter
Tires—$3\frac{1}{2}$" front and rear.
Speeds—5, 8, 12, 15 miles per hour.
Upholstering—Cloth and leather.
Top—Coupe (interchangeable).
Steering—Side lever.

Woods Queen Victoria. Pacific Motor Car Company, San Francisco.



Battery—40 cells, 9 M V.
Wheels—Artillery
Drive—Side chain.
Tires—Solid rubber.
Speeds—[illegible] speeds up to 18 miles per hour.
Mileage—5[illegible] on one charge.

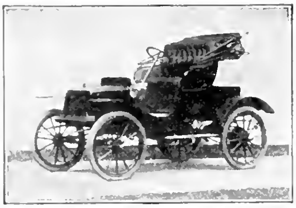
Waverley Victoria. Western Electric Vehicle Company, Oakland, Cal.

Battery—30 cells, Exide National and Waverley.
Motor—One Waverley.
Wheels—30" wood.
Tires—4", detachable.
Speed—5 to 16 miles per hour.
Drive—Herringbone noiseless.
Brakes—Two foot, one electric.
Steering—Side lever.
Top—Coupe.

THE BABCOCK ELECTRIC AUTOMOBILE.

It is just about ten years ago since Edison predicted that in this length of time there would be practically no horses used upon the highways of the big cities of this country, and that the electric vehicle would have revolutionized both pleasure and commercial traffic. While "the wizard" has not accomplished the battery which would be the storer of commercial energy of which he then dreamed, yet tangible evidences of the comparative realization of his prediction have come in the presence here, at the time of the Electric Vehicle Convention last week at the St. Francis Hotel, San Francisco, of the 1910 Babcock electric victoria. This car was selected not only as the highest type of electric carriage, but the one capable of an exhibition run up the 16 per cent grade of California street hill last Saturday and negotiating it at 15 miles an hour, much to the surprise not only of the enthusiasts of the "electric," but of the gas-car representatives, as well.

The new Babcock has won the trophies in all electric stock-car contests during the past year in which it has been entered, and including such notable events as the Fort George Hill climb, New York City; the Stanley Hill climb, Cincinnati, O.; the treacherous hill climb at Williamsport, Penn.; the Arrowhead Hill climb, Long Island, N. Y.; the famous Wheaton Fair contest at Chicago, etc., and in many of which the "Babcock" beat the record of gasoline cars of national repute. In addition, this wonderful "electric" has made exhibition runs of from 110 to 120



miles on one normal charge of the battery, and last October made a 1,244 mile run through Illinois, without accident or a broken part.

When the car arrived in San Francisco the skeptics said it was "no use," that other "electrics" had endeavored to satisfactorily negotiate the hills of this city but abandoned their agencies for such level territories as Oakland and similar cities. The "Babcock" soon dissipated these pessemistic views, however, with astonishing exhibitions on the hills usually selected for the most strenuous demonstrations to be made by high-powered gasoline and steam cars.

The secret of the admitted success of this "Electric," is its new French-type of battery, which Mr. Babcock secured abroad a year ago, and which is standard in England, France and Germany; its new type of controller and by which all the energy delivered is utilized without waste; its exclusive high-speed motor; its lightness of construction, and a simple device for control, together with an irreversible steer, which give the "Babcock" a safety and simplicity heretofore unknown in "electric" vehicles. In addition to its unusual mile radius, the "Babcock" can be made to attain a speed of about 35 miles an hour, if desired, and a lady can drive it.

The "Babcock" has demonstrated that it not only combines more than a hundred miles on one charge with the usual speed of a gas car, but that it can duplicate its performance day after day without injury to its battery.

OGDEN, UTAH.—The water works committee of the City Council has its plans well under way for the improvement of the municipal system. The first work undertaken will be the Five Points extension which will require about 16,000 feet of 6-inch pipe. This will necessitate the purchase of about 10,000 feet of pipe as only 6,000 feet are on hand for the work.

NEW WIRING SUPPLIES BUILDING CONSTRUCTED BY THE GENERAL ELECTRIC COMPANY.

Ever since the first commercially successful incandescent lamp was placed upon the market, the manufacture of wiring supplies, such as sockets, receptacles, cutouts, switches, etc., has been a growing industry. It has kept pace with the many developments that have been made in the incandescent lamp, and today it is one of those branches of the electrical industry which may be classed as a distinct and separate art in itself.

With the increasing use of electricity for heating and power purposes the demand for wiring supplies has also increased to such an extent that their manufacture has grown to be a business of large proportions and importance and one requiring a high standard of inventive and constructive skill. In order to meet the demand the General Electric Company has recently constructed at its Schenectady plant a specially designed building for the manufacture of wiring supplies of all kinds.

Fig. 1. Exterior Wiring Supplies Department Building.

The building, as shown in Fig. 1, is of modern fireproof construction and is thoroughly equipped in every respect for this class of work. It is four stories in height, 400 feet long, 85 feet wide in its narrowest dimensions and has a total floor space of about 150,000 square feet. Reinforced concrete is used throughout in the construction. The interior of the building is equipped with a fire extinguishing sprinkler system that appears adequate for a wooden structure of equal size.

Fig. 2. Shipping Floor Wiring Supplies Department Building.

All partitions are of reinforced concrete and asbestos wood, so that a very small percentage of combustible material enters into its construction. General Electric enclosed arc lamps with large corrugated reflectors furnish a well diffused light during the late hours of the day. At other hours ample natural illumination is afforded by numerous windows on each floor.

All machinery within the building is driven by electric motors, the motors being connected directly to the machine in a great many cases. High ceilings, pure air, plenty of daylight and ample working space are the favorable conditions under which the employees work. These conditions will be appreciated by those who know that better work can be done and more accomplished when the surroundings are healthful and inspiring. A lunch counter on the third floor is a further convenience for the employees. This enables the operatives to lunch within the building if they do not desire to go to the other works' restaurants.

Electrically operated passenger elevators are located at each end of the building. Freight is handled by a large electric elevator located in the center wing. Concrete stairways are provided near each elevator to give ready access to each floor.

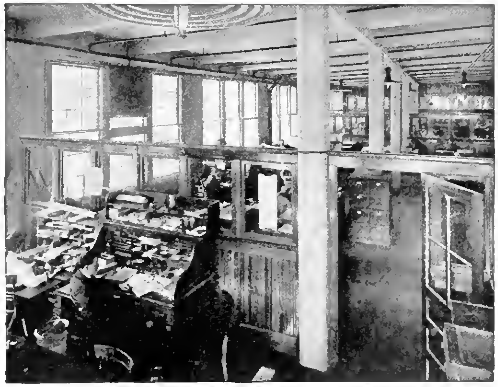


Fig. 3. General Offices Wiring Supplies Department.

In Fig. 2 is shown a view of the boxing and shipping department which occupies the first floor. Freight cars may be run from end to end of this floor and also to the center wing in which the large freight elevator is located. The elevator is of sufficient capacity to carry the cars to any floor.

The mechanical department occupies the second floor. This department contains a large number of electrically operated machines which are divided into several groups or divisions. Machinery for the production of dies, tools, moulds, etc., are grouped in one part of this floor, while presses for punchings, metal casings, etc., are placed together. Automatic screw machines also form a separate group. Miscellaneous machine operations, including drilling, tapping, stamping, spinning, etc., are concentrated in another part of the room. A part of this floor is also divided off for polishing, dipping and plating operations.

Fig. 4. Exterior Porcelain Building.

The assembling department occupies the third floor. This floor is devoted entirely to the building up of the numerous parts into a complete and finished article ready for boxing

and shipping, and has accommodations and facilities for about 1,000 operatives. The assembling operations on this floor are also divided into several divisions. For instance, socket and receptacles are assembled in one section and cutouts and attaching plugs in another. The same may be said of fuse plugs, snap push button and small knife switches, enclosed and open type fuses and distribution cabinet panels. Here also the sealing and pitching operations are performed. On this same floor the assembled devices are placed in boxes and labelled.

The offices of the department are situated on one end of the fourth floor. Fig. 3 shows the offices of the managing engineer and his force of designing engineers, draughtsmen, production clerks, and cost clerks. On this floor facilities are also provided for electrical and mechanical testing of the completed devices and for the production of models. A force of experienced model makers are daily engaged in making up preliminary models from which the moulds, dies, and tools are formed for the production of the finished article.

The productive capacity of the Wiring Supplies Building, if worked to what may be termed its maximum full load output, would be about one million five hundred thousand separate and complete devices every week. This output represents a diversity of devices, such as key and keyless sockets and receptacles designed to meet every conceivable condition of service and for every variety of series and multiple lamps of all shapes, sizes and candlepower; automatic safety cutouts, enclosed and open type fuses, non magnetic and magnetic blow-out types for all currents and voltages, and for use wherever automatic protection is required; surface snap switches of all capacities, with and without indicating features for all classes of open and concealed wiring; flush pocket snap and pendant switches, and well push button types, and ceiling and knife blade switches for every service with and without fuses. Cabinet panel boards for all classes of wiring, and for all voltages and currents are also manufactured together with attachment and connection plugs for lighting and heating service.

Some idea of the operations involved and the labor and material required in a "rush week" output may be obtained when it is remembered that each device is made up of several materials, including porcelain, copper, brass, bronze, fibre, mica, etc., and each separate part is created from the crude material, and shaped, stamped, drilled, tapped and finished by appropriate processes and machinery. The numerous parts are accurately and securely assembled together, and representative samples of each line are periodically tested for mechanical durability and also for electrical endurance under overloads which represent the very worst conditions of actual service. These tests are made so as to satisfactorily fulfill certain specifications of design and service, and also to secure the approval of the factory inspection system.

An exterior view of the buildings in which the porcelain and compound parts are made is shown in Fig. 4. These buildings are directly opposite the Wiring Supplies Building and only a few hundred feet distant. This is a very valuable convenience, as it enables porcelain and compound parts to be transferred to the Wiring Supplies Building as quickly as they are needed.

In this connection, it is interesting to review the early history of the manufacture of wiring supply devices, and to contemplate the smooth and unhindered progress of the early manufacture of these devices, and their freedom from competition and from the examination and scrutiny of the city and insurance inspectors.

The first commercial lamp socket was designed and used about thirty years ago. It was cylindrical in form and made of cherry wood. Two metal contact strips arranged diametrically opposite each other made contact with two similar strips on the lamp base. A few years later the present screw shell form of contact was invented and proved such a simple and effective means of conducting the current to the lamp, at the same time securely holding the lamp within the socket, that it has remained to the present time the accepted standard method of attaching lamps, attachment plugs and fuse plugs to sockets, receptacles and plug cutouts.

At this period receptacles, cutouts and switch bases were also made of cherry or apple wood. It was of course quite natural that the early designer of wiring devices should have selected wood as the most suitable material from which to make the bodies and bases of these small fittings. Wood of all varieties was everywhere available at small cost. Other materials which have since replaced wood for these details were not then considered within the reach of manufacturers in quantities and price that would compare with wood, especially as wood was capable of being easily machined and shaped to any desired form, and filled, treated and protected to meet any peculiar condtions of service.

During the year 1883, however, slate and porcelain were applied to commercial forms of lamp fittings, and has now for some time replaced wood with its serious disadvantages of warping, splitting and carbonizing under high temperatures.

NEW DEVICES FROM PASS & SEYMOUR.

Pass & Seymour, Incorporated, Solvay, N. Y., have several new devices which they are presenting to the trade, and which are illustrated herewith

P. & S. No. 480 and 481 are to replace the old style removable rubber ring fastening, which style the Underwriters

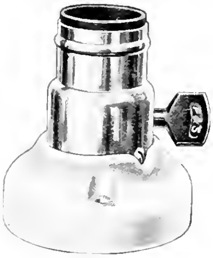
480

481

do not sanction. The base is recessed to allow for the projection of tubes or conduit ends.

Nos. 482 and 483 also have this latter feature, but with the all porcelain base as illustrated.

These devices being used for concealed work will naturally have to cover an opening in the wall. In the past all devices of this type have been made with bases too small and the screw holes have been so located that it was difficult for the receptacle to be properly fastened. In these



482

483

types the large bases with the consequent wide separation of the supporting screw holes take care of this possible condition and insure a workmanlike job.

The price is not high and the quality is the same as that which characterizes all Pass & Seymour goods, namely, nothing but the best.

NEWS NOTES

FINANCIAL.

PASADENA, CAL.—Bonds amounting to $150,000 have been issued for the purpose of enlarging the municipal lighting plant.

MESA, ARIZONA.—An ordinance has been passed by the city trustees providing for the issuance of bonds amounting to $50,000 for the purpose of constructing water works for the city of Mesa.

SAN FRANCISCO, CAL.—The tenders of the Pacific Gas and Electric Company 5% bonds for the investment of $250,902.77 in the sinking fund, just opened, indicate, in all $843,000 bonds tendered from 85 to 105 and $286,000 were taken from 85 to 88.65, the average being 87.7916, or about eight points higher than last year.

SAN FRANCISCO, CAL.—Hon. W. F. Chandler, one of the directors of the Associated Oil Company, states that in all probability the company will pay dividends beginning about August. No fixed rate of payment will be declared but dividends will be paid at such times as the directors deem advisable. The annual meeting of the directors of the company will be held this week and maters concerning the granting of dividends will be discussed at that time.

SAN FRANCISCO, CAL.—The Assessors of San Francisco, Alameda and Santa Clara Counties have filed with the Board of Supervisors statements of the assessed valuation of the Spring Valley Water Company in the various counties for use in connection with the rate making investigation. The report from the Assessor of Alameda is as follows: Real estate, $386,300; improvements, $32,900; personal property, $4,100,000; total $4,519,500. The statement for San Francisco County is: Real estate, $1,330,380; improvements, $648,280; personal property, $912,507; total, $8,889,167. The Assessor for Santa Clara County reported a total assessment of $69,990. The totals for the three counties amount to $13,478,657.

SEATTLE, WASH.—The report of the Seattle Electric Company for the month of December and twelve months ended December 31 compares as follows:

	1908	1907
December gross	$ 415,079	$ 376,805
Expenses	253,801	229,582
December net	$ 161,278	$ 147,223
Charges and taxes	83,802	76,689
Balance	$ 77,475	$ 70,534
Bond sinking fund	11,511	7,280
December surplus	$ 65,964	$ 63,254
Twelve months, gross	4,520,488	4,119,724
Expenses	2,670,252	2,421,404
Twelve months, net	$1,850,236	$1,698,320
Charges and taxes	989,374	832,941
Balance	$ 860,862	$ 865,380
Bond sinking fund	101,271	87,360
Twelve months, surplus	$ 759,591	$ 778,020

SAN FRANCISCO, CAL.—On the motion of the Knickerbocker Trust Company of New York, Geo. H. Whipple has been appointed receiver for the Stanislaus Electric Power Company and Vanderlynn Stow receiver for the Tuolumne Water Power Company. This is another move toward the combining of the two companies and the formal taking over by the United Railroads. By the terms of the sale the present $6,000,000 issue of first mortgage bonds of the Stanislaus company are to be surrendered for second mortgage 40-year, 5 per cent bonds, non-foreclosable before July 1, 1914, the stock of the reorganized Stanislaus company is to go to the United Railways Investment Company in exchange for $900,000 of preferred stock and $900,000 of common stock at par. First mortgage Stanislaus bonds to the amount of $5,500,000 will be issued to complete the hydro-electric property and not more than $1,000,000 additional bonds to develop the distributing system. Energy will be supplied for 44 years at 7.5 miles per k.w.-hour. The new power company will have a peak capacity of 48,000 k. w. under the present plans.

INCORPORATIONS.

LOS ANGELES, CAL.—The Hannon Water Company has been formed here with a capital stock of $6,000 by F. A. J. V., C. D., J. E., and F. Hannon.

LOS ANGELES, CAL.—The Soquel Canyon Oil Company has been incorporated here with a capital stock of $20,000 by R. W. Poindexter, T. S. Wadsworth and M. F. Brack.

LOS ANGELES, CAL.—The Perry Electrical Works has been incorporated here with a capital stock of $100,000 by Robert March, A. S. and L. Perry, H. E. and H. A. Hayden.

HANFORD, CAL.—The Lillian Cil and Mining Company has been incorporated here with a capital stock of $100,000 by S. Rehoefer, E. E. Bush, F. Richardson, C. E. Chastine and Jos. Barbeiro.

LOS ANGELES, CAL.—The Yucaipa Water and Lumber Company has been incorporated here with a capital stock of $100,000 by G. D. Bailey, G. E. Fairhead, E. M. Giffen, L. R Wharton and F. A. Holmes.

NAPA, CAL.—The Forest Park Land and Water Company has been incorporated here with a capital stock of $200,000 for the purpose of buying and selling land, owning reservoirs, etc. The incorporators are: A. P. Cross, railroad promoter of Los Angeles, Attorney John L. McNab of Ukiah, and William Kirk of Napa.

SAN FRANCISCO, CAL.—The San Francisco Electric Railways has been incorporated with a capital stock of $10,000,000, to build two and one-half miles of street railway in this city. The articles not only state the route which the new line will take through the city but they also give the company the general right to build on other streets not named. The incorporators of the company are: Lewis F. Byington, Frederick V. Scott, John R. Tyrrell, John F. Forbes and W. H. Orrick. John F. Forbes has been chosen treasurer of the corporation.

TRANSMISSION.

BREMERTON, WASH.—The Peninsula Light and Power Company has a contract to supply light and power to the Bremerton Navy Yard.

MISSOULA, MONT.—Several water rights in this vicinity have been secured by the Idaho Water and Electric Power Company preparatory to building a power plant.

REDONDO, CAL.—The steel pier and 600 feet of approach to the Starr Wave Motor Company's plant was entirely destroyed by the high seas which prevailed last week. The pier and machinery cost upwards of $100,000. The company has not announced its intention of rebuilding the plant.

BAKERSFIELD, CAL.—The Edison Electric Company's electric power plant in the Kern River Canyon was so badly disabled by the severe storms of the past few weeks that it has become necessary to shut down until the necessary repairs can be made. Rush orders have been sent for new generators and repairs will be hastened as fast as the machinery arrives.

TELEPHONE.

OAKLAND, CAL.—Bids for the sale of a telephone franchise outside of the incorporated towns of Alameda county were called for by the board of supervisors this week and will be opened March 29.

SAN FRANCISCO, CAL.—At the annual meeting of the Pacific Telephone and Telegraph Company of which 55 per cent of the capital stock is owned by the American Bell Telephone Company, the following directors were elected: H. T. Scott, J. C. Ainsworth, F. C. Bradley, F. J. Carolan, J. C. Cebrian, Edward Coleman, W. H. Crocker, F. G. Drum, F. W. Eaton, M. Ehrman, Louis Glass, Geo. D. Greenwood, Timothy Hopkins, Homer S. King, Theodore N. Vail, O. J. Woodward and E. J. Zimmer. The board of directors have organized and chosen Henry T. Scott, president; E. C. Bradley, vice president and general manager; E. J. Zimmer and Louis Glass, vice presidents; and F. W. Eaton, secretary and treasurer. The surplus earned during the year, over all expenses, fixed charges and dividends, on the preferred stock, amounted to $695,471.01, or nearly 4 per cent on the common stock.

ILLUMINATION.

OKANOGAN, WASH.—A light and power plan for this city may be built by R. P. Rodemyer of La Crosse, Wis.

ST. JOHNS, OREGON.—Extensive additions may be made to the gas plant here. C. R. Donnell is secretary of the company.

STOCKTON, CAL.—The Stockton Gas and Electric Company has been granted a franchise to lay gas pipes in the streets of this city.

ALAMEDA, CAL.—The Electricity Commission of this place has plans for the addition of at least 150 additional electric street lamps.

GRASS VALLEY, CAL.—The Pacific Gas and Electric Company announces that it will soon begin installing electric light and power meters in Grass Valley and Nevada City.

LEMOOR, CAL.—The board of trustees have advertised for sale the present municipal electric light and power plant with all personal property belonging thereto. Bids will be received until March 1st, 1909.

LOS ANGELES, CAL.—C. S. Chestnut, of Redlands, has become sole owner of the Colton Gas Company. Mr. Colton will enlarge the capacity of the plant so that the company can supply the several near-by cities.

MOSCOW, IDAHO.—The City Council has granted Andrews & Clark a gas franchise, provision being made that work shall begin within sixty days and that not less than $3,000 shall be expended within six months.

GLENDALE, CAL.—Frank Campbell, L. C. Brand, J. F. McIntyre and D. Griswold of Glendale are planning to form a company with a capital stock of $150,000, for the purpose of furnishing electricity and gas to this town.

ANAHEIM, CAL.—The Anaheim Gas Company has purchased for upwards of $100,000 the gas company of Orange. The works will probably be moved to Anaheim, and the consumers of Orange served by a pipe line from Anaheim.

SILVER CITY, N. M.—The New Mexico Light, Heat and Power Company has been purchased by J. B. Downey, of Denver, Colorado. Mr. Downey states that the entire plant is to be improved and that upwards of $15,000 will be spent in putting it in first class condition.

EUREKA, CAL.—At the annual meeting the stockholders of the Humboldt Gas and Electric Company, the following directors which held office during the past year were reelected: W. S. Clark, J. M. Carson, Henry Deering, George Murry and H. Vance. The company plans during the coming year to increase the capacity of its plant at Junction City on the North Fork of the Trinity River.

SALT LAKE CITY, UTAH.—The Utah Light and Railway Company is planning to make improvements to its plant which will cost in the vicinity of $500,000. Plans are being made for ordering a second 75-ton, 3,000 horse power, motor-generator costing $35,000. An emergency plant is also to be erected at the Jordan River, with steam power equal to one-half the total demands now made on the present plant. The engines to be installed here are to be of the turbine pattern, those being found the most economical in operation.

TRANSPORTATION.

LOS ANGELES, CAL.—H. F. Vollmer has been granted a franchise by the City Council for a double track electric road on certain streets in this city.

LOS ANGELES, CAL.—Sealed bids will be received by the City Council up to March 23, 1909, for a twenty-one-year double track electric street railway on certain streets of this city.

SACRAMENTO, CAL.—George W. Peltier, of the Central California Traction Company, which line is now in operation between Stockton and Lodi, announces that the company intends building and completing before the end of the year its proposed line in Sacramento.

OIL.

LOS ANGELES, CAL.—It is reported here that the Standard Oil Company has decided on the early installation of fifty new drilling rigs at an outlay of $250,000 and an expenditure of fully $500,000 in the development of oil wells in the territory tributary to this city.

SAN FRANCISCO, CAL.—The following cargo shipments of refined petroleum were made in January to the Orient from this customs district, all but the last mentioned, which cleared for China, going to Japan: Tuscora, 2,291,844 gallons, valued at $103,128; Winnebago, 1,900,000 gallons, valued at $85,500; Ashtabula, 2,246,469 gallons, valued at $110,091; and Tonawanda, 1,800,000 gallons, valued at $81,000; total, 8,238,313 gallons, valued at $379,719. During the same month there were the following three clearances of fuel oil for the Orient, the first being for Chile, the second for Honolulu and the other for Panama: Santa Maria, 1,680,000 gallons, valued at $24,000; Fullerton, 630,000 gallons, valued at $9,000; and Lansing, 1,680,000 gallons, valued at $24,000; total, 3,990,000 gallons, valued at $57,000. The records show an increase of nearly five million gallons in refined oil and of about a quarter of a million gallons in fuel as compared with January, 1908.

WATER WORKS.

OAKLAND, CAL.—The City Council at its last meeting decided on the reduced water rate partially arranged for at the preceding meeting. It is claimed that the total saving to the city will reach $800,000.

BAKERSFIELD, CAL.—Oil men on the West side are signing contracts for a year's supply of water at four cents a barrel with a new company promoted by R. B. McCauley of Los Angeles, who is said to be backed by English capital. The plan is to pipe water from Pine Mountain, 40 miles south of Midway.

SAN DIEGO, CAL.—Plans are under way for laying almost four miles of new water mains in Ocean Beach Park. The Board of Public Works has recommended to the City Council the purchase of $75,000 worth of cast iron pipe to be used in extensions in various parts of the city. The funds for the improvements were provided for in a bond issue voted in 1907.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer — who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

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Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Marshall Elec. Co.
Pass & Seymour.
Perkins Elec. Switch Mfg. Co.

ALARMS

BURGLAR ALARMS

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Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc.
Western Electric Co.

FIRE ALARMS

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Western Electric Co.

WATER ALARMS

Partrick, Carter & Wilkins Co.

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Klerulff, B. F. Jr. & Co., "Hubbard."
Klein & Sons, Mathias.

ANNUNCIATORS

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Stanley & Patterson, Inc.
Western Electric Co.

ARMS

CROSS ARMS

Klerulff B. F., Jr. & Co.
California Pole & Piling Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

MAST ARMS

Elec. Appliance Co., "Cutter"
Ft. Wayne Electric Works.
Klerulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher"

TELEPHONE TRANSMITTER ARMS

Dean Electric Co.
Elec. Appliance Co., "Eaco."
Klerulff, B. F., Jr. & Co., "Sterling."
Sterling Elec. Co.
Western Elec. Co.

INDEX TO ADVERTISEMENTS

ASBESTOS

Johns-Manville Co., H. W.

BATTERIES

DRY BATTERIES

Dean Electric Co.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

DRY BATTERY HOLDERS

Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES

Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY

Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

STORAGE BATTERIES

Elec. Storage Battery Co.
Westghse Machine Co.

BELLS

ELECTRIC BELLS

Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

ELECTRO-MECHANICAL GONGS

Edwards & Co.
Electric Goods Mfg. Co.
Marshall Elec. Co.
Partrick, Carter & Wilkins Co.

MAGNETO BELLS

Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

BOILERS

Henshaw-Bulkley & Co.
Keystone Boiler Wks., "Parker."
Moore & Co., Chas. C., "B. & W."
Standard Electrical Works, "Robb-Mumford."
Tracy Engineering Company, "Edge Moor."

BOOKS

Technical Book Shop.

BOXES

WALL BOXES

Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knockout."
Chicago Fuse Wire & Mfg. Co., "Union."
Cole Co., John R., "Bossert."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
General Electric Co.
Harvard Elec. Co.
Holabird-Reynolds Elec. Co.
Marshall Electric Co.
Sprague Electric Co., "Universal."
Standard Elect'l Wks., "M & M."
Stanley & Patterson, Inc., "Simplex."

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity Power and Gas *604 Mission Street, San Francisco.*

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.

Journal of Electricity, Power and Gas,
604 Mission Street, San Francisco.

AGENTS WANTED on a guaranteed weekly salary to represent our two publications, "Southern Engineer" and "Southern Machinery"; liberal terms for exclusive services; easy sellers; every engineer and every machinist is interested. Write at once. For further information, address W. R. SMITH PUB. CO., Sub. Dept., Atlanta, Georgia.

WANTED—Men coming in direct touch with Steam, Electrical Superintending Engineers and Shop Foremen. A proposition that can be handled by energetic persons to good advantage. Liberal commission and permanent work. CHAS. L. TURNER, 907 Atlas Bldg., San Francisco, Cal.

POSITION WANTED by an experienced electrician with some business ability. First-class references on this Coast. Will accept low salary if opportunity for advancement. Address Box 102, **Journal of Electricity.**

FOR SALE at bargain prices: Two 6-wide, 9-high, 18 ft. Babcock & Wilcox wrought iron front boilers in first-class condition. For particulars, see B. W. RICE, 1419 Metropolis Bank Building, San Francisco.

FOR SALE at a bargain—3-25 K. W. 1040/2080 to 230/460 volts, Gen. Elec. Oil Transformers; have been used but a year; are in perfect operative condition; change made to higher voltage. Address Hood River Elec. Lt., Pr. & Water Co., Hood River, Ore.

SITUATION WANTED—By electrical engineer with 15 years' experience in designing and estimating of electric power plants, switch gears, light, motor and storage battery installations; also in central station service. Advertiser takes also draughting work in this line as home occupation if no steady engagement can be attained. Moderate expectations. Address Box 101, **Journal of Electricity,** San Francisco.

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Stanley & Patterson, Inc., "Sunlight."

DESK TELEPHONE BRACKETS
Stanley & Patterson, Inc., "Imperial."
Sterling Elec. Co. "Equipoise"
Western Electric Co

IRON POLE BRACKETS
Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co. "Cutter."
Pierson, Roeding & Co.
Western Elec. Co, "Fletcher"

BURNERS

ELECTRIC GAS LIGHTING BURNERS
Electric Goods Mfg. Co., "Advance."
Edwards & Co.
Welsbach Company.
Western Electric Co., "Edwards."

CABLES

SUBMARINE AND LEAD-COVERED
American Electrical Works.
Belden Manufacturing Co.
Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
National Conduit & Cable Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
Standard Electrical Works "Simplex."
Standard Underground Cable Co.
Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

PAPER INSULATION
Belden Manufacturing Co.
Nat'l. Conduit & Cable Co.
Western Electric Co.

TELEPHONE CABLE
Dean Electric Co.

CARBONS

ARC LIGHT CARBONS
Brooks-Follis Elec. Corp'n, The, "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The, "I-T-E," "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
Kierulff, Jr., & Co., B. F. "Hartman."
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLEATS

FIBRE CLEATS
Blake Signal & Mfg. Co.

PORCELAIN CLEATS
General Electric Co.
Holabird-Reynolds Elec. Co., "Electric Porcelain."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Elec. Co., H. D. Sears, general sales agent.
Western Elec. Co., "Thomas"

WOOD KNOBS
Blake Signal & Mfg. Co.

CLUSTERS

FIXTURE CLUSTERS
Benjamin Electric Mfg. Co., "Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbell."

COILS

ARMATURE AND FIELD COILS
Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Deltabeston."
Westghse Elec. & Mfg. Co

INDUCTION COILS
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co
Western Electric Co.

SPARK COILS
American Electrical Works.
Electric Goods Mfg. Co.
Western Electric Co.

COMPOUNDS

BOILER COMPOUNDS
Dearborn Drug & Chemical Works.
Johns-Manville Co., H. W., "Magic."

CONDUIT

FLEXIBLE CONDUIT
American Circular Loom Co., "Circular Loom."
Cole Co., John R., "Circular Loom."
Sprague Electric Co., "Greenfield."

RIGID CONDUIT
American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct," "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roeblings Sons Co., J. A "Navalite."
Cole Co., John R., "Electroduct."
Sprague Electric Co., "Iron Armored."

UNDERGROUND CONDUIT
Johns-Manville Co., H. W., "J.-M."
Pierson, Roeding & Co., "Fibre."
Roeblings Sons Co., J A "Bituminized Fiber"
Walworth & Neville Mfg. Co
Western Electric Co., Agents Walworth & Neville Mfg. Co.

CONNECTORS

CABLE CONNECTORS
Belden Manufacturing Co.
Chicago Fuse Wire & Mfg Co.
Harvard Elec. Co.
Kierulff, B. F., Jr. & Co.

CORD

FLEXIBLE BELL CORD
American Electrical Works.
Belden Manufacturing Co.
General Electric Co.
Kierulff, B. F. Jr. & Co., "National."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roebling Sons Co., John A.
Simplex Elec. Co.
Western Electric Co.

LAMP CORD
American Electrical Works.
Belden Mfg. Co.
Elec. Appliance Co., "Paranite."
General Electric Co.
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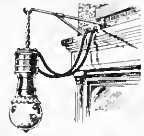

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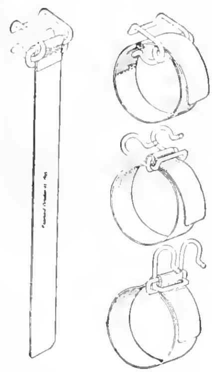

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TANGENTIAL WATER WHEEL EFFICIENCIES.[1]

BY GEORGE J. HENRY, JR.

It is not the writer's intention to attempt to determine the equation for the so-called true hydraulic curve, or to exhibit new and improved bucket shapes which will greatly increase the efficiency of a water wheel, but rather to discuss some of the well-known shapes of buckets and particularly the ellipsoidal as compared with the general form of the Pelton bucket.

The conclusions arrived at are not theories deduced entirely on paper, but are the result of a very elaborate series of experiments carried out since 1899 in the special laboratory of the Pelton Water Wheel Company with a view to scientifically and practically determining, beyond a doubt, the relative advantage of different bucket shapes. The printed information on this subject heretofore has been extremely misleading, to say the least, and usually the result of incomplete theorizing within very narrow limits. The conclusions arrived at have usually been entirely different from those that would have been obtained had the theorist taken into account, instead of neglected, certain factors of extreme importance to the deductions.

5000 K. W. Pelton Wheel for Electra Plant, Pacific Gas and Electric Corporation, to Operate Under 1400 ft. head at 1400 r. p. m.

We will not again parade that elusive ghost—"a new bucket shape"—that is conjured up by every suburbanite with a "mechanical turn of mind" who has wielded a garden hose. It is our intention, however, to present a few facts for your worthy consideration, and particularly to those of you interested in obtaining the best results from water wheel plants.

During the writer's experience in the design, construction and operation of tangential water wheels for the past twelve years, new types of tangential water wheel buckets have been brought out with startling rapidity; every rain seems to bring out a new crop—like mushrooms. Most of them do not last any longer than mushrooms. Some few, due to liberal advertising, are forced before the public, but usually die a natural death after a short time, as much because of poor engineering or financial disability, as weakness in bucket design. The average inventor fails to consider the work of those who have gone before, and suffers from the belief that if the patent office will grant a patent there must be superior results obtainable. Or, rather than giving actual results, such as Prony brake measurements on carefully designed wheels for comparison, he will state that it will "reverse a Pelton" when put on the same shaft, etc., all of which means nothing as far as relative efficiency goes.

Another frequent fallacy is that to get maximum efficiency it is only necessary to provide a bucket which will receive one blow at each revolution, usually at the instant of entering the stream.

To obtain the best efficiencies it is necessary to have the proper pipe line, gate valves, nozzles, water wheels and buckets, wheel case, wheel pit and tail-race, and all of these parts must be properly designed for the particular conditions under which they are to operate, and all will vary with the head or pressure—the water quantity and the revolutions which the wheel is to make. Many a water wheel bucket has been overworked for years, and then charged up with losses that occur because of its being improperly worn, due to this overwork. Again, buckets

[1]Reprint, by request, of paper read at Seventh Annual Convention of the Pacific Coast Electric Transmission Association, June 16, 17, 1903, and published in The Journal of Electricity, Power and Gas, of September, 1903.

are frequently charged up with all kinds of losses which are really due to something for which the bucket is not responsible. Pressure or wheel diameter, or speed on a given wheel, cannot be varied radically without materially altering the efficiency. Many hydraulic plants are in operation and developing not over 65 per cent. between the flume and water wheel shaft where the *bucket* itself is capable of developing 90 per cent., and where a very inexpensive change could be made which would increase the gross efficiency very materially and cause a great saving in the water bills.

On the other hand, there are probably more errors made in buckets than in any other one element of a tangential water wheel plant. The writer knows of but one inventor, Mr. L. A. Pelton, who has based all of his work on tangential wheels on actual practical results obtained through laborious experimental work. All other shapes, as far as we know, are the result of a happy, or, usually, an unhappy thought, and it is curious to note how at variance are the shapes and arguments put forth to support each type as it is introduced.

The Cazin bucket is built up on the entering lip and cut away on the sides, which are made rectangular, and Mr. Cazin issued quite a mathematical treatise, in the form of a trade catalogue, to prove the value of his type of bucket.

The ellipsoidal type of bucket is cut out in front like the Dodd, and is supposed to contain smooth interior cavity surfaces, whereas the De Reamer has a number of interior ridges or walls to guide the water in fixed lines along the surface of the bucket cavities. In the ellipsoidal, before mentioned, great stress is laid on the smooth interior surfaces from which 1 or 2 per cent. is supposedly gained, and then the front is largely cut away, resulting in a loss usually much more than is gained by the smooth surface.

Some inventors insist that buckets should discharge from the top or edge nearest the wheel center, such as the Risdon and Hug. Others, again, that the discharge should be from the front and side furthest from the center, and still others, that this discharge should be from the sides, as in the Cazin, Berry, Blue and Pelton. This latter class is by far the more numerous.

In actual practice, each bucket, of course, discharges to some extent on all three sides of the cavity, but the maximum discharge may be distorted to any particular point by changing the interior surface of the bucket cavity. Some inventors insist on periphery. In fact, the whole question of bucket design seems to be largely a matter of guess work, usually based on assumptions entirely at variance with facts, and therefore leading to wrong conclusions.

An inspection of the stream diagrams, made from actual experiments, will make this question of stream path over the surface of the different bucket shapes better understood. It should be borne in mind that the bucket is doing work throughout its entire path, within the stream lines, and we therefore give the lines taken by the water in three different positions of the bucket. First, at the moment of entering; second, at the point of developing maximum power, and third, in its final position before leaving the stream. In these diagrams the same relative bucket and wheel and stream dimensions are maintained for each form, so that comparisons may be more readily made.

With these diagrams before us, let us bear in mind that to obtain the best possible bucket efficiency it is necessary that the water jet be taken up on the bucket surface and brought to as near rest as possible with the least loss of energy. This loss will then be made up of:

1. The discharge velocity with which the water leaves the bucket with respect to a point fixed in space. Note that this velocity will vary with every position of the discharge as bucket ....

2. Air and surface friction inside the bucket.

3. Imprisoned water in the bucket.

4. Variation in the stream form, producing erratic conditions of impact and flow on the bucket surface.

5. That occasioned by the stream being displaced by the entering bucket.

6. Eddy currents in the buckets.

7. Water which does not give up all its energy to the bucket (a special case of the first condition mentioned above).

The following methods of correcting these losses suggest themselves:

1. If the water moves in a curved path on the bucket surface, being taken up on a surface as nearly tangent to the entering jet as possible, and is turned through a curve of as nearly 180 degrees as possible, still allowing the discharge to clear the back of the next bucket, and the discharge is at the same distance from the wheel center at all times, the first loss will be kept down to a minimum.

2. If the water moves in a smooth curved path at all times, as shown in the Pelton bucket diagram (Photo A) and the stream form is retained, spreading out gradually and encountering no hard corners or angles, and the discharge is thin and fan-like on the sides, and the least number of buckets used, then the air and surface friction will be a minimum.

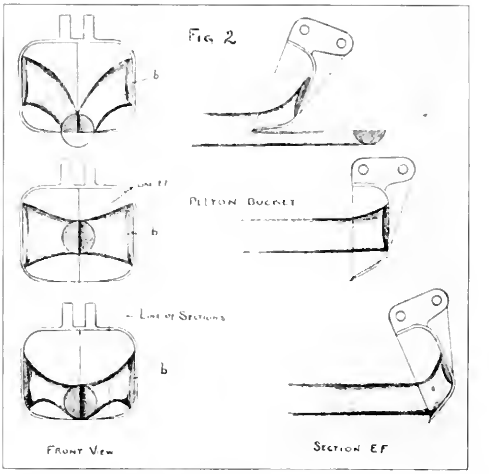


Photo A. Diagram of Discharge From Pelton Bucket. Note Thin Fan-Like Discharge at B.

3. The imprisoned water will cause very little loss if the bucket surfaces are smooth and so shaped on the back and front that the water, after expending its energy, will freely leave the wheel.

4. Variations in stream form producing erratic conditions of impact and flow will be avoided by carefully following the angle of the front and the curvature of the cavity surfaces.

5. The shape of the cutting edge and the dividing knife, and their relative angles to the stream, are the principal causes of the loss occasioned by the displaced stream.

There are still other losses which should form an important consideration in wheel design, but which are not directly affected by the bucket shapes. These are:

8. Journal friction.

9. Windage due to the wheel acting as a centrifugal blower.

10. The losses in the nozzles, gate valves and pipe lines.

Every water wheel plant has all of these losses to a greater or less extent, and it is obvious that when 80 per cent. is then obtained from an operating wheel, the improvement of any one of these, or, for that matter, the entire elimination of any single loss, if this were possible, would not, to any great extent, improve any wheel's gross efficiency. The writer has a number of times obtained as high as 90 per cent. efficiency in laboratory test on buckets only.

Let us give some attention to the above detailed losses, and endeavor, as far as possible, to determine those points, the careful calculation of which will obtain for us the best possible tangential water wheel bucket.

1. Given a certain stream of water at a given spouting velocity, it is advisable that this be taken upon the bucket surfaces of just enough buckets to catch every particle of water on the dividing wedges and turn it all on the curved surfaces, and discharge it at just enough velocity (and entirely in a direction at right angles to the entering stream axis) to clear the next following bucket. This resulting velocity will be the tangent of the discharge angle, multiplied by bucket velocity.

2. The air and surface friction must be maintained as small as possible by the use of a nozzle which will give a perfectly circular and solid stream. The bucket surface and cutting edges must be of a shape which, with a minimum wetted surface, will allow the stream, without crowding at any point, to spread out in a thin fan-like discharge on each side. The surface must be such that the water will not adhere, and as smooth as possible.

The surface may be ground and polished, or better, ground and well painted with a special compound. If all of these points are carefully studied out and the front of the bucket properly shaped and not cut away too low, the imprisoned water will not cause any appreciable loss.

The windage will also be a minimum if the number and surface of the buckets is a minimum.

The above losses and considerations for their prevention are all of such a nature, and so entirely interdependent, that their quantitative value cannot be predetermined except in a general way. In designing a water wheel, however, it is certain that the exercise of the most careful judgment is necessary in the laying out of the surfaces, so that all the losses, or at least their sum, or total bucket loss, will be kept down. Thus, if too much bucket surface be allowed, we increase both surface friction and windage for a given output, and if we attempt to cut these down by reducing the surface, we crowd the stream,

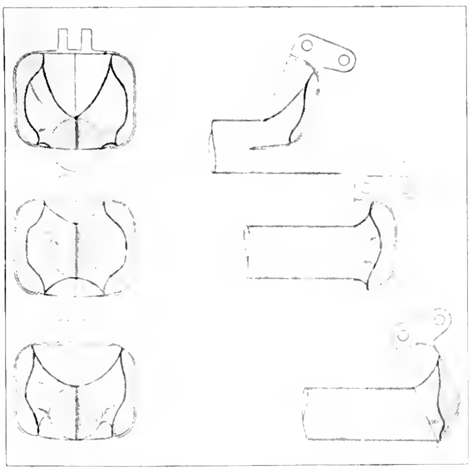


Photo B. Diagram Showing the Effect of Overcrowding a Water Wheel Bucket Resulting in Uneven Mechanical Erosion Cutting Out the Corners Rapidly.

so that eddy currents will occur and the stream will not properly discharge from the bucket side, as shown in Photo B.

It will now be seen that it is absolutely impossible to get equally as good results from a certain shape of bucket, under all conditions of wheel and stream diameter and water pressure, but that to get the best efficiency, a bucket must be designed for each set of conditions.

When an investigator says, "Suppose no frictional resistances exist in the bucket, and let the stream be prevented from spreading laterally—also neglect losses due to impacts, loss of head in the nozzle, journal friction and resistance of the air"—however interesting a conclusion he may come to mathematically, the result to the purchaser or the builder is not only entirely useless, but frequently misleading to a dangerous degree.

By carelessly omitting some of the above considerations many makers who have obtained very good results on some one wheel, fail to secure even a reasonable efficiency from others,

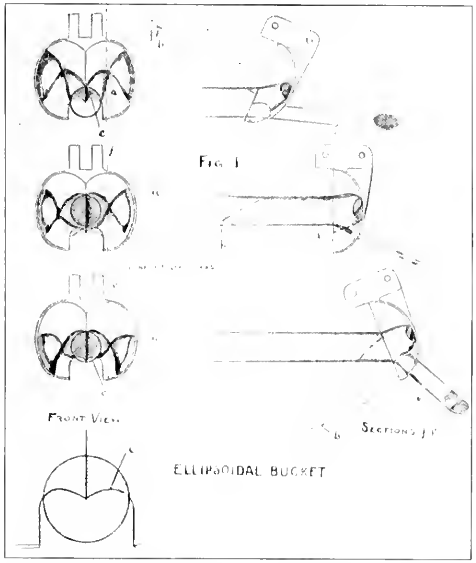


Photo C. Diagram Showing Path of Water in an Ellipsoidal Bucket in Its Different Positions. Note Point of Disturbance at A, Flat Impact and Division in Two Planes at C, Nodes of Discharge B. Leakage of Pressure Water E.

built on similar lines, but for working under different conditions.

The writer believes that there is no such thing as a bucket shape, which, by simply enlarging or reducing, may be adapted to any set of conditions.

Some of the familiar bucket types are grossly deficient in the most elementary requirements for efficiency and best practical results.

All bucket shapes may be divided into two classes, in the first of which we have a variation in the shape of the cups on each side of the dividing wedge, and the second in which we vary the front wall or entering lip. Let us give some attention to these two points.

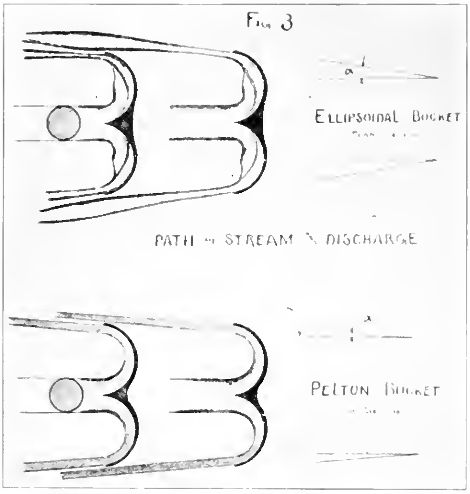
In the first place, no stream of water can divide on the central wedge and gradually spread out, if the surface of the bucket is concave with a deepest point (See Photo C), as there will be a tendency for all the lines of flow to cross on this point c and then spread out again after passing over it. This crossing or "impact accumulation" and the consequent eddy currents at the deepest point cause more rapid wear here than elsewhere, as also a considerable reduction in efficiency. The water again spreads out, after crossing the deepest point, but before leaving the side of the bucket the curvature of the walls tends to produce a second node, as shown at *b*. It is the writer's belief that there should be no single deepest point in a water wheel bucket, but rather that the flowing stream, after impact on the dividing wedge, should follow, practically, a cylindrical surface, so that the stream may spread out in a fan like shape at discharge, as shown in Photo A.

In reference to the front of the bucket, this should be neither too high nor too low. If the front be too high, as in the Cazin,

then it must be set at such an angle of entry to avoid disturbing the stream, that there will be eddy currents set up; if too low, all the water will not be caught without a great increase in bucket surface. Under no circumstances should the entire front be left out as in the Berry and Doble as used at Blue Lakes.

Some wheel builders state that if the bucket has any front in line with the stream, this "slaps" or "pushes" a portion of the stream out of the way and accordingly reduces the efficiency by this amount of lost stream. This is not the case by any means, as far as the design of Pelton bucket is concerned, but on the contrary, the stream enters perfectly and entirely without disturbance. In a bucket with a front wall and properly designed throughout, the solidity of the stream is not interfered with, even to the slightest extent, until impact commences on the central interior dividing knife. All buckets which show wear and have been properly set and operated confirm this, as no wear occurs on the exterior of the front wall. The bucket here illustrated, although worn out on the inside, is clean on the front wall and back. See Photo D.

Another fallacy shared in by many engineers is the mis-statement that a bucket without a front wall cuts the stream in but one place. Nothing could be further from the truth. Every bucket with a dividing wedge, splits the stream in two places. One of these being the plane of rotation through the central wedge, and the other containing the boundary line of the bucket and parallel with the wheel axis, that is by the front of the bucket whether high or low. The stream is thus divided into three parts at the intersection of the two planes, as shown in Photo Ce and Photo E, illustrating the ellipsoidal bucket.



Ce Plan View of Buckets Showing the Thin Discharge Occurring From the Pelton and Smooth Flow in the Cavities.

Any bucket having a central dividing wedge divides the stream into two planes, whether the bucket has a front wall or not. There are no exceptions to this rule, and by the very nature of things it is impossible for a bucket to enter the stream without cutting the stream with the front or bottom surface parallel with the shaft. This double plane division occurs in the buckets of the Pelton, Risdon, Dodd, Hug, DeReymer, Ellipsoidal and Berry, and the more nearly the stream (in both divisions) is taken up in the line of flow, the better the efficiency that will be obtained.

With buckets of the Berry and Ellipsoidal types, a large percentage of the water entering each bucket strikes a comparatively flat portion of the bucket. See Photo Ce. If we bear in mind that the efficiency of a flat surface running under the same conditions is theoretically only fifty per cent., and practically much less, than when received on the wedge, we readily see that this loss, due to part of the stream striking on a flat surface drags down the efficiency that would be obtained if the bucket were provided with a curved front surface or entering lip.

In regard to the division of the water jet in two planes: Consider for a moment any bucket in a position where the stream is partly entering it and the remaining portion of the stream passing on to the bucket next ahead; then that portion which enters the first bucket, has been divided by one plane, namely—that passing through the bucket front line—and again in the bucket division has occurred on the central wedge or it is clearly split into three parts by two planes. The accompanying Photo E is of an ellipsoidal bucket in which the patentee claims this does not occur and where the three sections by two planes are clearly shown. (See, also, Photo EE.)

We do not see how anything would be gained in the way of efficiency, if the division into three parts could be avoided, as has been erroneously claimed by the inventor of the ellipsoidal bucket. The entry of the bucket front line into the stream, if properly made, can be the cause of but an infinitesimal amount of power loss, if any, which we are by no means prepared to admit. In fact, a bucket, to give anywhere near a proper efficiency, in addition to the reason given above, must have a considerable front wall, otherwise, after impact has occurred on

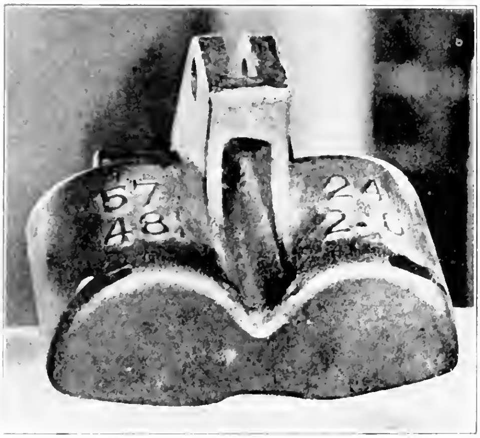


Photo D. Pelton Bucket Showing Absence of Wear on the Back and Front Wall Although Bucket is Worn Through Due to Long Continued Use With Too Large a Stream.

the bucket surface, the jet will spread, and a large percentage of it find its way out, without having given up more than a small part of its velocity, and therefore its energy. This is not only so during entry, but during the entire passage of the water through the stream, and, as paradoxical as it may seem, it is a fact, that a greater disturbance in the stream, as far as those conditions which should be maintained for maximum efficiency are concerned, is caused by cutting down the height of the front wall below the splitting wedge than by leaving it well up. This is not a theory nor mathematical deduction, but a readily demonstrable fact which any interested parties may very easily prove.

There is another branch of this subject which is of considerable interest, and one, if carefully studied, that leads us to very important conclusions, viz., the erosion or bucket wear which occurs in every plant to a greater or less extent. As stated before, the course followed by a stream of water, after impact on a Pelton bucket, is such as to give a discharge almost entirely from the side of the bucket. This is shown diagramatically in Photo A, and also experimentally in Photos F and G.

In this latter photo we have a stationary Pelton bucket receiving the correct size stream and discharging it from the sides. The course taken by the discharge will be slightly different as

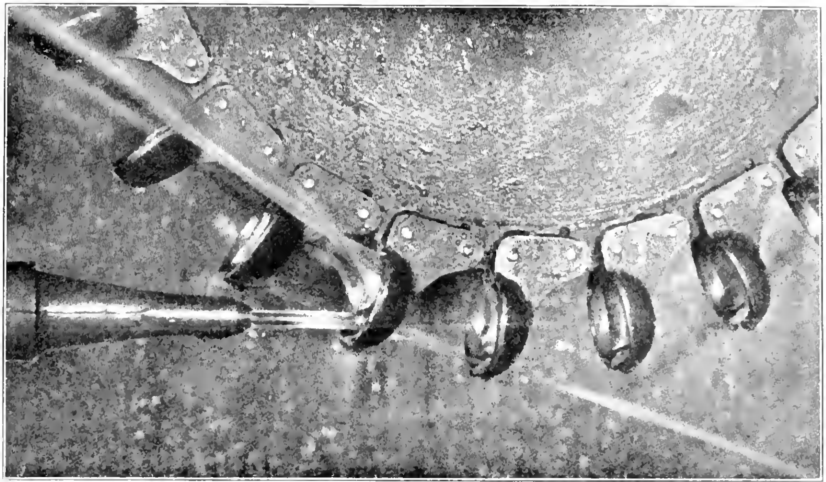


Photo E. Ellipsoidal Bucket Showing the Stream Division in Two Planes and the "Nodes" in the Discharge Water Like a String in Vibration Instead of a Thin Fan-Like Discharge. Compare Photos C, G, H, T.

the wheel rotates, but the discharge will always be parallel with the entering jet, as illustrated in Photo H. If these statements are correct, we would find in properly designed and installed Pelton plants, where all the adjustments and sizes of streams used were correct, that the buckets would wear evenly, at least for a considerable time, until the slight pits, which almost invariably occur, would start local action, resulting in considerable wear spreading around these pits.

It is a fact worthy of notice, although I think not mentioned in the discussion on "erosion" at last year's proceedings, that erosion met with in hydraulic practice is usually of two kinds. First, we have that due to the impact of cutting particles, which acts exactly as a sand blast—the sharp corners of the quartz sand particles cutting away the material of the bucket surface. A bucket eroded by this process is shown in Photo P. Secondly, we have a chemical erosion or corrosion, occasioned, I believe, by the escape of imprisoned air or air or other gas in solution, which released suddenly under high pressure may carry with it a certain amount of nascent oxygen, which on the clean metal surface would promote rapid oxidation. It usually starts at any imperceptible inequality in the castings, such as infinitesimal blow holes. The water moving over the surface and jumping across the blow hole crater releases the oxygen of the air, possibly more readily than the nitrogen. This gives us a small pocket, or blow hole, having clean surfaces from the water friction, filled largely with oxygen gas. The oxygen combines with the clean metal, forming an oxide coating, which is cleaned off by the water friction, which will invariably occur at the slightest change in position of bucket. The result is that the oxidizing process is repeated—the hole rapidly growing larger.

We would expect, if the above theory of chemical erosion is correct, to find the oxidized pits, as they become larger, increasing more rapidly in the direction of the bucket wedge, or creeping towards the direction from which the stream ap-

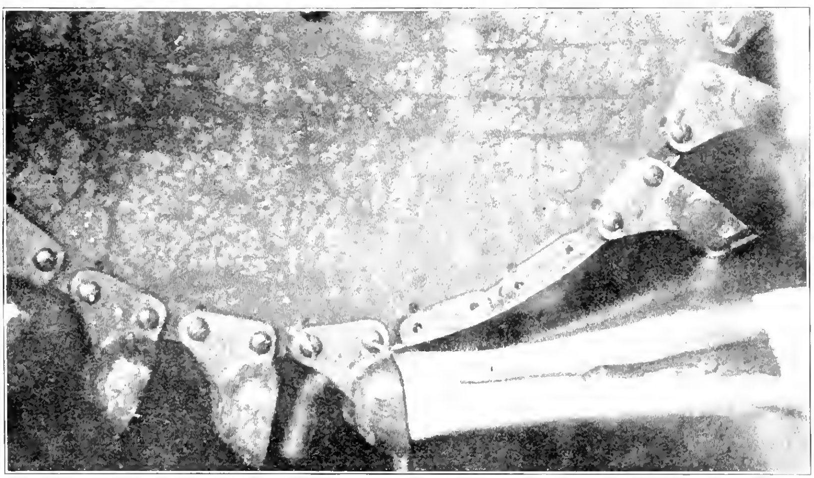


Photo G. Pelton Bucket Showing Parallel Discharge From Bucket Sides.

proaches, rather than from it, as the oxygen would naturally be released on the side of the pit from which the stream approaches. Such seems to be actually the fact where we can obtain an example of chemical erosion independent of mechanical erosion.

Photo J shows you a bucket taken from one of the wheels at the Santa Ana Station of The Edison Electric Company after

Photo EE. Ellipsoidal Bucket Showing the Twist in the Discharge and the Leakage of Pressure Water Through the Front Even Though Stream Has First Fully Entered the Bucket Cavities.

about twenty-seven months [illegible] which it was driving a 750-kw. [illegible] from a single stream under about 700 feet head. Here you will [illegible] pits above mentioned, which [illegible] the oxidized

Photo F. Tangential Water Wheel Fitted With Pelton Buckets Showing the Discharge at Almost Zero Velocity (the Individual Slow Moving Drops of Discharging Water Are Observable) and That the Shape of the Jet Is Maintained Until Impact in the Center of the Bucket Where the Entire Energy Is Removed From the Water by the Bucket Resulting in Maximum Efficiency.

[illegible] from the smooth steel [illegible] of these pits [illegible] would be re[illegible] mechanical erosion [illegible] surface of most of our water wheels.

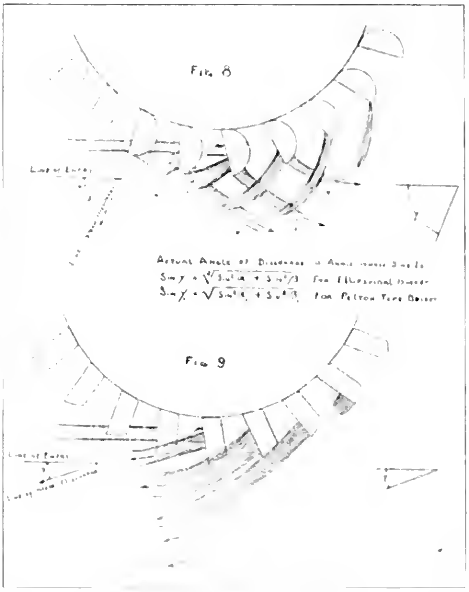


Photo H. Diagram Showing the Path of Discharge From the Ellipsoidal Bucket (Figure 8) and From the Pelton Bucket (Figure 9).

Photo I. Diagram of Chemical and Mechanical Erosion Originating at Points F and G Respectively and in the Nozzle Tip Which Is a Scale Drawing From a Tip Eroded in Actual Operation—Chemical Erosion Originating at A.

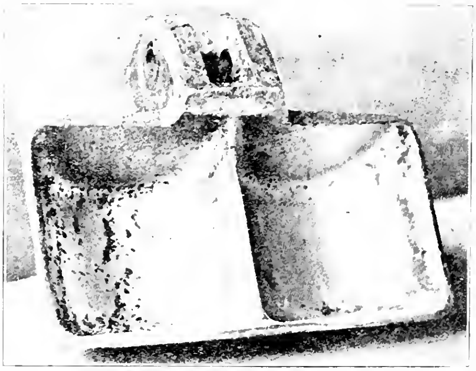


Photo J. Cast Steel Pelton Bucket From the Edison Electric Company's Santa Ana Station Showing the Even Wear When the Proper Size Stream Is Used; Showing Also the Chemical Erosion and Oxidized Pits in the Steel Surface. The Original Paint Is Still Observable on the Backs and Edges of the Bucket After Several Years' Use.

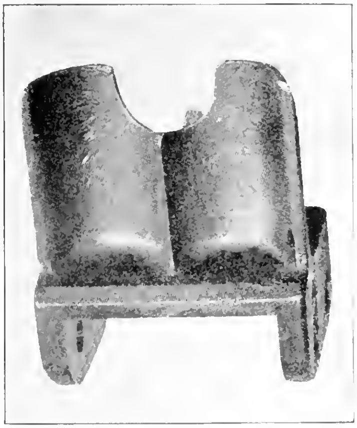


Photo K. A Bucket From One of the Early Blue Lakes Wheels Showing the Impact on the Flat Surface and the Chemical Erosion on the Inside.

we would find the dividing knife, or splitter, the most heavily worn part. This, however, is not the case in most instances, the pitting usually occurring in the bottom and sides of the cavities. It will be readily seen that, after these pits grow large enough to alter the course of the water, they will completely change the path of the jet in the bucket cavities, and we will then have all sorts and kinds of erratic shapes, which shapes are in no way governed by the original curves of the buckets. We thus find on the same wheel buckets worn through in entirely different spots, bearing absolutely no similarity to each other, although they all started out under exactly equal conditions.

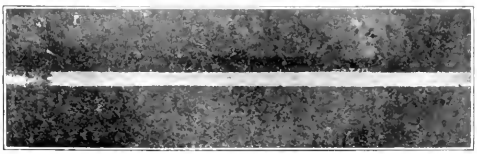


Photo L. A Water Jet From a Standard Pelton Tip.

The small bronze Doble bucket with the open front, originally used in the Blue Lakes plant, Photo K, clearly shows the beginning of this pitting process and also the direction of the water flow over the bucket surface. This direction of flow also shows the impact, on a comparatively flat surface, in open front buckets of this type, as mentioned before, unless built with a front wall.

In water jets carrying imprisoned air, or air or gas in solution, due to the high pressure, we would expect to find, on relieving this pressure, a gas discharge from the outside of the stream. Photo L shows you a stream under fifty-foot head, carrying air in solution. The stream at the instant of leaving the tip is perfectly clear; an instant later, or about two diameters from point of issue, we find a slight enlargement of the stream, which the writer believes to be due to the imprisoned gas freeing itself on the relief of pressure. This disengaging process continues in this instance for about fifteen stream diameters, after which the stream begins to again clear up, although at no point is its rigidity or shape interfered with.

Photo M shows you another example, and under such radically different conditions as to lead me to the belief that this condition exists throughout the entire field of hydraulic practice. You see here a jet from a Pelton needle nozzle under a pressure in excess of 1900 feet head at the plant of The Edison Electric Company in Southern California. The jet is of a size suitable for developing an overload on a 750-kilowatt generator, and the fog or "water dust" immediately surrounding the jet shows clearly the disengagement of imprisoned gas. This is best observable at from one to ten diameters from the tip, and is undoubtedly a condition that exists on the bucket surface, as well as immediately surrounding the jet at point of issuance.

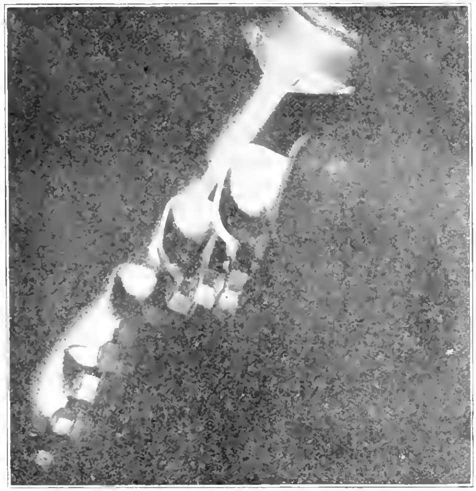


Photo M. A Stream of Water From a Pelton Needle Nozzle Under 1923 Feet Head at the Station of the Edison Electric Company, Los Angeles, Developing 86.2 Per Cent. Efficiency.

Photos N and O illustrate a needle nozzle under comparatively low pressure, and the water dust is here also observable at from five to twenty stream diameters distant from the tip. In each of these cases the stream is in particularly good focus, and the water dust was more clearly observable in the investigations

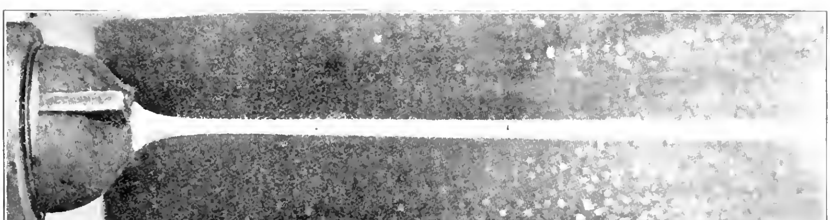


Photo N. A Stream of Water From a Pelton Needle Nozzle.

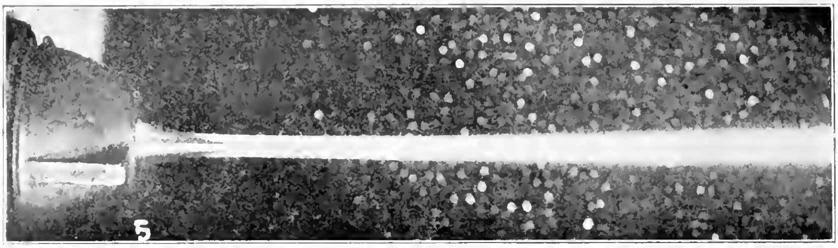


Photo O. A Stream of Water From a Pelton Needle Nozzle.

accordance with the laws of least resistance, the oxygen or other gas would be released in exactly the same way—causing the pitting surfaces inside of the nozzle tip.

I believe this to be the correct explanation of chemical corrosion, and think that in most cases in practice we have a combination of chemical and mechanical erosion.

Paint acts exactly as a sheet of paper or rubber cushion protecting a piece of glass under a sand blast—the paper or rubber not in any way being damaged by the impact of the particles of sand, but where cut away so that the glass is exposed to the cutting grains, the hard surface of the glass or of tool steel will be very rapidly cut. By holding your finger under the wheel blast, the finger nail is rapidly cut away, although the sand makes no impression on the softer skin surrounding it. The observation of this fact led the Pelton company years ago to adopt a special

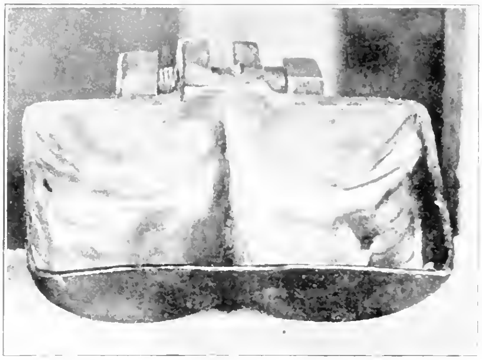


Photo P. Early Type of Pelton Bucket on Which Has Been Used Too Large a Stream of Very Gritty Water, a Combination of Mechanical and Chemical Erosion and Excessive Wear in the Corners Due to the Overcrowding With the Large Stream as Shown in Photo D. Note the Entire Absence of Wear on the Front Wall, Showing It Does Not Interfere With the Water Jet.

rule in regard to painting its buckets—the paint proving the best possible protection. In fact in regular operating plants, if the buckets are of good design and are kept thoroughly painted, they will last an indefinite length of time.

Photo P shows you the interior of a bucket, the back part of which is shown in Photo D. This bucket was overcrowded, as shown from the cutting in the corners. In spite of this the outside of the front wall is not worn in any way, due to the stream cutting the wheel. The slight wear on the dividing lip is not as great as on the dividing wedge inside the bucket. Considerable notoriety has been given by a competitor to a large Pelton bucket originally in use at the Nevada Power Company's plant on account of the unusual amount of wear on the back. This has been explained by parties unacquainted with the facts as having occurred as shown in Photo Q, Figure 4. The water does not, however, take this course through a Pelton bucket, as we have already shown you, Photo A, but takes the course as shown in Figure 5 and Figure 6 of Photo Q.

Figure 7 shows the way that the bucket in question received its wear. I have made several inquiries, endeavoring to get hold of this worn bucket to exhibit before you, but was not able to obtain it. It is no defect in the bucket curves if the back portion of the bucket is worn, due to water impact from some entirely different source than the bucket curves.

Photo F shows you a Pelton wheel in operation at the point

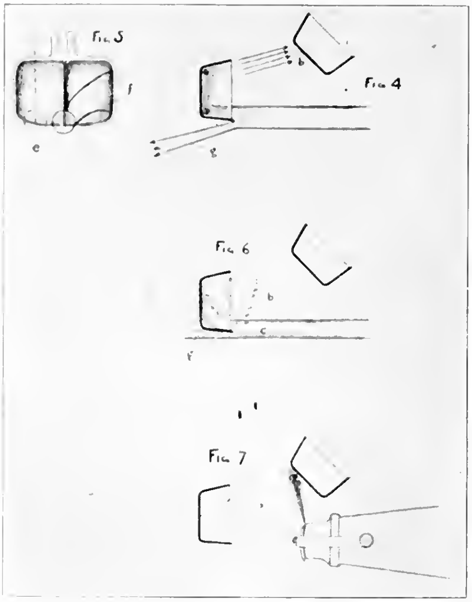


Photo Q. Figure 5-6, the Path of Water Jet Through the Pelton Bucket. Figure 4, a Diagram Sometimes Used but Incorrect to Explain the Wear That Occasionally Occurs on the Backs of Water Wheel Buckets. Figure 7 the Correct Explanation of Wear on the Backs of Well-Designed Buckets.

of best efficiency, and shows that the water impact and discharge all occurs vertically under the wheel center and within a very short arc of stream contact; that there is no disturbance occurring in the stream itself due to the front wall of the Pelton bucket entering the stream.

Photo S shows you a Dodd wheel in operation when running at its best efficiency, and showing the discharge of the water through the front of the bucket at a point further removed from the wheel center than the entering water as claimed in Mr. Dodd's patent.

This slide also clearly shows the water entering one bucket but not yet leaving it, the bucket having to advance several stream

Photo S. Instantaneous Photograph of Tangential Wheel Fitted With Dodd Buckets and Running at Maximum Efficiency Showing the Discharge From the Buckets to be Below the Point of Entry and All of the Stream Fully Caught in the Buckets and Reversed in Direction Resulting in High Efficiency.

than it is shown in the photograph. It is perfectly obvious, if this theory is correct, that much of the wear that occurs in the interior of nozzle tips would also be explainable. For it is certain that where changes of cross section occur, there is a corresponding change in stream velocity, and, when this is not in diameters before it begins to discharge. The second and third buckets are also shown still receiving the stream, and the fourth bucket is shown with the water leaving it, although no water is entering.

Photo T shows a wheel fitted with ellipsoidal buckets operating at point of best efficiency. One bucket has just started to enter the stream; the second bucket is in full action, the third bucket is just receiving the last particle of water, and the fourth bucket is just discharging the last particle of water. All of the buckets show clearly the loss of water through the open front wall, as pointed out above. This water still contains considerable energy, resulting in a large falling off in efficiency. The efficiency of this type of bucket will decrease as the head decreases, the result being that for large streams under low heads such a large quantity of water is lost through the front opening as to very considerably reduce the efficiency below that obtainable with buckets having a front wall.

Photo V shows one of the Pelton buckets at the Edison Mill Creek Station No. 3, which was painted with a single coat of asphaltum varnish, allowed to dry three hours and then put under operation, driving a 750-kilowatt generator at about full load for

Photo T. Instantaneous Photograph of Tangential Wheel Fitted With Ellipsoidal Buckets and Running at Maximum Efficiency Showing the Losses That Occur Due to the Stream Partly Discharging Through the Front Opening Before Energy Has Been Taken Out and Discharging From the Front Corners of the Bucket, Resulting in an Unnecessarily Large Discharge Angle, Reducing the Efficiency of the Wheel.

a period of twenty hours, after which it was shut down and this photo taken. The photo clearly shows from the surfaces where the greatest amount of varnish is worn away that the discharge

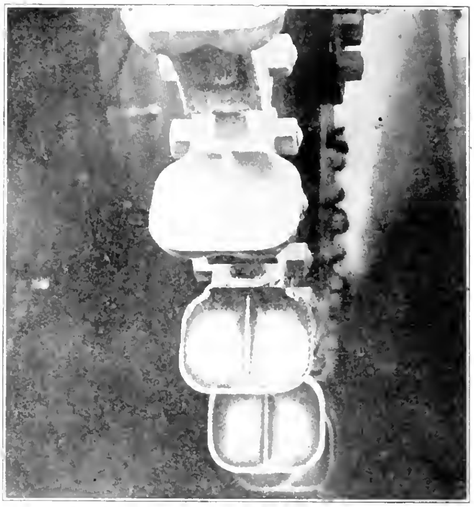


Photo V. Pelton Bucket at Edison Mill Creek Station No. 3 Showing by the Wearing Off of Paint After Twenty Hours' Run Under 1923 Feet Head That the Discharge Occurs From the Sides, as It Should for Best Efficiency.

occurred from the sides of the bucket and not from the top and front as has been sometimes claimed.

The inevitable conclusions are that the greatest care and best judgment must be exercised in designing a bucket for each case. Certain it is, the bucket should have a front wall, joining cylindrical surfaces, which meet in a central apex or wedge, as distinguished from open front types and those having cups with

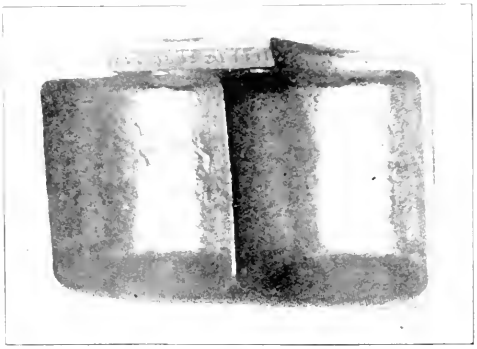


Photo W. Worn Bucket Showing Chemical Erosion Creeping Toward the Center Dividing Wedge.

deepest points in them, for the water to form eddy currents. It is a strange thing that mining companies will pay high prices for a miner's inch of water and then use it over cheap wheels, cheap only in first cost, but probably costing hundreds if not thousands of dollars each year in their extravagant use of water. Some power companies are doing the same thing, except on a more magnificent scale. This condition of things is similar to that case, all too frequently met with, of cheap steam engines and boilers, whose extravagant use in coal constantly keeps the owner's nose hard up against the grindstone. There is, however, this difference, a good water wheel, properly set and cared for, will always be efficient, if kept in good condition, whereas a good steam engine, if not in skilled hands, is more apt to deteriorate. A little conservative figuring will frequently demonstrate, beyond a doubt,

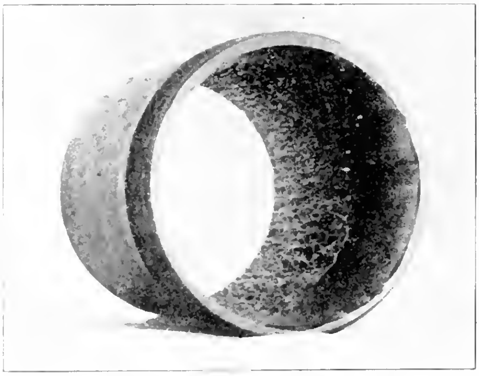
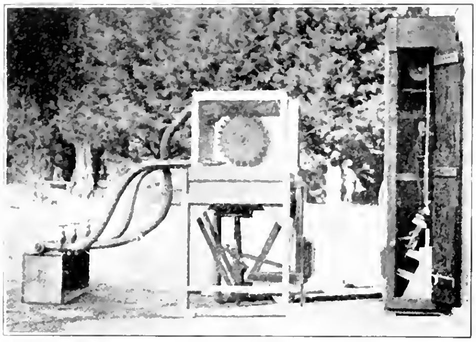


Photo X. Nozzle Tip Showing Chemical Erosion in Jar or Outlet End and Mechanical Erosion on Near or Inlet End.

that a property struggling along under a burden of indebtedness would be easily placed on a proper paying basis by the use of more efficient water wheels.



One of the Pieces of Experimental Apparatus as Used in the Investigation, Showing the Arc Light and Shutter for Illumination the Wheel and Nozzle Enclosed in a Plate-glass Case, Prony Brake and Accessory Measuring Apparatus.

COPPER MARKET SITUATION.

The copper situation reflects a distinctly cautious tendency on the part of buyers, and on that account the volume of recent sales have not squared with the records made in busy times. Mining goes right on at a heavy rate, however, and with new demand disposed to hesitate sellers beleved there were good arguments for reducing the price of Electrolytic Wirebars from $14\frac{1}{2}$ to $13\frac{1}{2}$. Outside of a few million pounds taken early in February by domestic and foreign interests at $13\frac{1}{2}$, according to current report, and some odd sales below those figures, the market has remained very quiet.

Although the copper market has settled to a lower level, and the immediate future of the metal is enveloped in considerable doubt, nevertheless, from our point of view we look for a gradual return to brighter business conditions. Manufacturing activities are so much greater than they were a year ago that no fair-minded person of ordinary intelligence can fail to appreciate the substantial progress made towards permanent betterment.

PROCEEDINGS PACIFIC COAST ELECTRIC VEHICLE CONVENTION, SAN FRANCISCO, FEBRUARY 19-20, 1909.

DISCUSSION ON "MERCURY ARC RECTIFIERS."

The Chairman: The paper is now open for general discussion.

Mr. A. C. Downing: There is one point about the rectifier that has come under my observation particularly, the effect of the rectifier on the electric automobile business of the pleasure type. In Indianapolis there are some 150 electric automobiles in use, and there are not over 25 of them kept in a public garage; all the rest are kept at home. That is one of the most notable effects of the rectifier on the business. It also works a great saving to the owner of the vehicle, in that it is free from the extra charges that a garage will slip in. In one instance they charged four dollars a month for acid. They cannot charge that when the owner has the car at home.

The Chairman: It might be well to bring out now, if any one has anything to say on the subject, the charging by the direct use of continuous current. In many cases continuous current is available, and the apparatus required and the efficiency obtained would be interesting to know.

Mr. G. A. McDougald: What is the efficiency of the mercury arc rectifier?

Mr. Alvord: The curve showing rectifier efficiency is on one of the screens; it shows the efficiency to be approximately 81 per cent. The efficiency charging on DC depends upon the relation between the battery and line voltages.

Mr. W. W. Briggs: There is no question of the rectifier having any advantage over the DC central station service, for the reason that the city mains are generally 110-volt, and on small batteries you would have to have rheostatic control. One thing that should appeal to the central station man would be the advocacy and the development of the private garage, where the current would be used when the central station was being operated at the time of light load conditions. A man naturally wants to ride around in his wagon in the daytime, and if he has it in the garage at night the central station gets the advantage of the night charging and the man gets his vehicle when he wants it. That brings about the necessity of an automatic charging plant. I might say that we have placed upon the market now an apparatus which is fully automatic. All the private owner has to do is to bring the vehicle into the garage and attach it to the rectifier, which automatically shuts off the current when the battery is fully charged. In the event of an interruption to the service during the charging, when the current comes on again the charging will continue automatically. If the battery were fully charged the rectifier would not start. That feature will appeal particularly to the private owner for the reason that with its use there is no need of a skilled attendant.

The Chairman: That is a very important point, that the rectifier will maintain the service independent of any interruption on the lines. (Laughter.)

The Chairman: Is there anyone here who has had experience with charging batteries direct with continuous current?

Mr. W. D. Vance: In charging ignition batteries we figure on about 18 3-cell batteries, 54 batteries on a circuit. We figure it costs us just as much to charge one as thirteen or fourteen; so we always try to get a full string before we attempt to charge any.

The Chairman: Can you describe the system which is used in New York, Mr. Murphy?

Mr. A. R. Murphy: The largest consumer there is the New York Vehicle Transportation Company. They have their own sub-station. Some years ago they bought 3-phase 25-cycle power of 6,600 volts from the New York Edison Company, and if I am not mistaken they had a 250-KW rotary converter installed. They aimed to keep a constant bus pressure. I do not remember what the exact voltage was, whether it was 100 or more. Then they used six cells for their high and low bus. These cells were of a large central station type. Most of their work was automatic, and really it was on such a large scale (where they were charging 100 or 150 batteries) that it is altogether foreign to anything that we will get in this vicinity for some time. It costs just as much to charge a small sparking battery as half a dozen. The best possible way to handle it is to get as many batteries as possible on the circuit, and the charging expenses per set are correspondingly cut down. We are using the ordinary rheostat, charging from DC circuits, and it is very inefficient. We have never tried to take measurements of the efficiency, but we know from the bills it is inefficient, for we find that in the months where little charging is done the bill is almost the same; in fact, we have almost a straight line of power charges from month to month. For that reason the mercury arc rectifier in connection with AC circuits is much better, because the control is better.

Mr. A. C. Downing: Mr. Churcher, of Cincinnati, one of the best posted men in electric automobile practice, in the care and charging of batteries, uses the stationary type of cell as resistance in charging from his DC line. In that way he saves the current, and in turn uses it for charging his sparking batteries, running his electric signs at night, and so forth. I think that is one of the best schemes that has ever come under my notice, when they have the DC to handle in a public garage.

The Chairman. Some years ago, when electric vehicles were first put upon the market, it was customary to have a larger number of cells per vehicle, usually from forty to forty-four. The reason that number was used was because they could be economically charged from the ordinary continuous current circuit. Resistance had to be used during the first half of the charge to control the rate and later the full voltage was put on to the battery. Since that time the electric vehicle people have found it more desirable to reduce the number of cells to, in some cases, thirty and twenty-four, and in other cases fourteen and twelve. That has changed very much the charging methods and has made the mercury arc rectifier very much more desirable.

Mr. F. T. Kitt. I would like to ask Mr. Alvord how much energy is wasted in resistance on that large set shown last. I believe there are two circuits in that, aren't there? And the one you have to have resistance in to cut your voltage down. You have practically the same as the direct current. You cannot vary the AC without interfering through the batteries charged except by resistance.

Mr. R. M. Alvord: That panel which we call the garage panel consists of a forty-ampere high-voltage rectifier panel and a distributing board. The idea is to charge two sets of three batteries each. If you have three sets of two batteries each, which are practically the same voltage, there is practically no waste in the rheostat, because the voltage can be so set that there is no waste. If you were to charge three sets of batteries on one side and two sets on the other, the use of the rheostat is to equalize the voltage between the two sides, and the loss is to that extent.

Unknown: Before adjourning I would like to ask what would be the effect if a large store like the Emporium used a lamp that would utilize the light given off by the rectifier, thus lighting its store and charging its battery at the same time, lighting the store practically free of charge. Could that be worked up in any way?

Mr. R. M. Alvord: One of the uses the rectifier is sometimes put to in a garage is to put it in the window. I know several places where they use the rectifier in the window. They do their charging right along and at the same time the peculiar color of the light attracts attention and advertises the garage.

Mr. A. G. Jones: As to the lighting of a drygoods store the mercury vapor lamp would be of little value. It is very important in a drygoods store or any place where color values are to be taken into consideration that a light producing more nearly the qualities of daylight is to be preferred. In a mercury vapor lamp the rays are practically devoid of red rays, and therefore it is not very satisfactory in any place of that kind.

Mr. F. T. Kitt: This gentleman thought that in the Cooper-Hewitt lamp there would be considerable waste of power, and in the mercury arc rectifier the light is wasted. I think in the Cooper-Hewitt lamp this is a very small loss of power. In the mercury arc rectifier the drop in the tube is very small, the amount of waste in the tube is very small, and consequently the heat cannot be very great.

Mr. A. H. Halloran: The question seems to be one largely of auxiliary apparatus. The Cooper-Hewitt lamp would be a very small part of the mercury arc rectifier. The main function of the rectifier is to furnish direct current, and the auxiliary apparatus is so designed as to be efficient and furnish the direct current as cheaply as possible, and the lighting effect is not sought. Photographers are using the Cooper-Hewitt rectifier occasionally, but in so doing the Cooper Hewitt lamp has been made efficient and does not employ all the auxiliary apparatus that is employed by the arc rectifier. The suggestion that a drygood's store be illuminated by the Cooper-Hewitt lamp is hardly feasible excepting in a window display or something of that kind to direct attention by the peculiar color of the light. The drygoods stores are installing tungsten lamps, or some form of lamp that will render the true color values of the goods. Would it be practicable to put a mercury arc rectifier on the vehicle? While the owner is getting his lunch his battery could then be charged.

Mr. R. M. Alvord. The rectifier device that is used for electric automobile charging now weighs 700 or 800 pounds, and

it is just a question of designing the machine whether it would be practicable on the machine or not. I believe there is some use being made of the rectifier in connection with transportation problems, but not on electric automobiles.

Mr. G. R. Murphy: Could not that weight be materially reduced?

Mr. R. M. Alvord: I doubt very much if the weight could be materially reduced. The metal casings and the panel would probably reduce it to 500 pounds.

Mr. F. T. Kitt: I would say that I think that could be done. You can get the 220 volts; you can charge the battery with a bare tube and a little resistance. I have run a tube just for an experiment right off a three-wire system on the house without any transformer, except a small inductance to smooth out the wave, and it worked very successfully; but I think a good many tubes would be broken.

Mr. W. W. Briggs: I think some experiments have been made on those lines. The limit is the lamp tube, and I think the General Electric and the Westinghouse have been working on the lines of a bulb instead of a glass, so that it will be more rugged for a rectifier. That is very much in the future.

Mr. A. H. Halloran: Recently silica has been used in the manufacture of chemical apparatus. It can be heated to a high temperature and dropped on the floor without breaking, and it is possible to substitute it for glass in many chemical cases, and it is quite likely that it could be used in the mercury arc rectifier tubes.

The Chairman: If there is no further discussion on this subject I would like to bring before you something that has occurred to me, and that is, that we might possibly form a permanent organization, call it the Pacific Coast Electric Automobile Association, or something similar to that; the purpose being to promote the use of the electric vehicle. Along those lines, if that meets with your approval, I would suggest that you in some way select a committee at this time—maybe three—to draw up, at least temporarily, some by-laws, and to submit them at our dinner to the delegates on Saturday night. At that time we can adopt the by-laws and elect officers. What is your pleasure in this matter? You have ample time between now and then to do all the electioneering you want to.

Mr. Kitt: I believe that would be a very good scheme, and believe that you knew the men here better than anybody else and could therefore select those best fitted for the purpose. I move that you appoint a committee for that purpose.

Mr. George C. Holbuton: I second that motion.

The Chairman: It has been moved and seconded that the chair appoint a committee to draw up by-laws for a permanent organization.

The motion was formally carried.

I will appoint on that committee Mr. Kitt, Mr. Downing and Mr. Halloran.

The next paper is by Mr. Murphy, and as it is now late, nearly lunch time, it might be well to adjourn and come together at 1 o'clock.

DISCUSSION ON "VEHICLE BATTERIES."

The Chairman: The subject of batteries is now open to discussion.

Mr. F. T. Kitt: I would like to ask Mr. Murphy about freshening charging of batteries, as to how much that should be carried out when a battery is not in use.

Mr. G. R. Murphy: That depends on how much it is out of use. I should say in a general way that if a battery is out of service about two weeks—not used during that time—I would give it a freshening charge at the end of that time. I would not put any time limit on it at all, but I should say that it would take anywhere from one-half hour up. It might be that there is a large amount of sediment in the cells, and it might take a longer time to bring it up than if the cells were clean.

Mr. F. T. Kitt: Just simply bring up the acid and the voltage?

Mr. Murphy: Yes. It is well to follow both, as one will serve as a check on the other.

Mr. F. T. Kitt: I have a battery not in use for a long time, and when I would charge it up the voltage would come up in half an hour. I do not know whether to leave it on longer than that.

Mr. G. R. Murphy: Sometimes in an old battery it takes much longer. I would not let a battery go without charging it at least once in two weeks. In sparking batteries, where the discharge is low and where they are discharging all the time, they might not have to be charged for six or eight weeks, but I am speaking mostly of propulsion vehicles.

Mr. A. H. Halloran: One of the principal objections to the use of the storage battery in electric automobiles is that of weight. One-third of the weight of an electric automobile consists of its battery, and to eliminate this so-called fault a great many attempts have been made to find a more efficient battery than the old one. One of the best-known is the Edison battery. The positive and negative plates are perforated nickel-plated iron. The positive plate perforations are filled with oxide of nickel and pulverized carbon, the latter to increase the conductivity. The negative plate is made of oxide of iron, and pulveried carbon is also added. The electrolyte consists of 20 per cent. solution of caustic potash (KOH). It is not dissipated, merely acting as an agent to carry the oxygen from the positive to the negative plate. The charging current enters the positive plate and in so doing oxidizes the nickel to and reduces the negative plate to spongy iron. The main advantage that the Edison people urge is that of great voltage capacity per unit of weight. The watt efficiency is 60 per cent. The weight of efficiency is from $11\frac{1}{2}$ to $12\frac{1}{2}$ watt hours per pound. That basis of reducing the number of watt hours to pounds has not been brought up by Mr. Murphy, and if he would make such a statement it would probably give us a good idea of the relative efficiency. This question of weight, however, is not as important as is usually figured, and probably does more harm to the electric automobile industry than any other question brought up, because every automobile has to have a certain weight to impart the necessary tractive effort. I would like to ask what the weight efficiency is of the old storage battery.

Mr. G. R. Murphy: I do not remember. I have not the figures here. I think Dr. Kennelly read a paper in 1901 on the nickel and iron cell, and I think the discussion brought out that the voltage of that type of cell had a much lower limit. For the same kilowatt output and for the same voltage you would need a greater number of cells; I think the weight of efficiency is much lower than the lead, but I do not remember the exact figures.

Mr. A. C. Downing: I have some data on the Edison battery as compared with the standard lead. In my experience in selling automobiles I do not know of anything that has held back the sale of machines more than the publicity given to the Edison battery by newspaper writers that are exploiting and have to have stories to keep their jobs, and there has been a good deal put out that there is absolutely nothing to, and some of it, of course, is what we all hope will be some time. But here are the comparisons: The capacity is rated at 25 amperes for six hours. The first discharge was 25 amperes for $5\frac{1}{2}$ hours. After 100 discharges it gave 25 amperes for $4\frac{1}{2}$ hours, showing a great drop in capacity. The evaporation is one of the great things we have to contend with. In Washington, D. C., the Adams Express Company are using Edison batteries exclusively; they have to fill their batteries about three times to twice with the ordinary lead plate. That entails quite a deal of work over the lead plate. In regard to the sediment: The pockets that you speak of are intended to be everlasting as near as a mechanical proposition can be, and after a hundred discharges they found there were five grams of sediment. That is practically nil. The temperature after a hundred discharges was 100 degrees Fahr. That, of course, will remain approximately the same as the other. On the test the separation of grid and material was lower. Of course, that was due to the action on those grids. The foaming is a serious trouble on account of the corrosive effect of the fumes. That was found in handling those batteries in quantities. They have on the top of the Edison cell an automatic valve so as to relieve the gas, because when the pressure becomes so great it had to be relieved. If it did not, the cell would blow up. I had occasion to sell four machines in one city and there would hardly a day go by for four months but it was necessary to send a new cell down there for one blowing up. Another experience we had was, the first cells were made with soldered joints and the solder was affected by the acid, and the manufacturers changed to an electrically welded jar. They changed the cell afterwards. The watt efficiency of the lead storage battery is 75 per cent., and the Edison 50 per cent., therefore the Edison requires 50 per cent. more current. The voltage potential difference of Edison is 1.2, the lead 1.96; therefore 1.04 more. The design of the vehicle would have to have considerably larger carrying space for the Edison battery over the exide. The exide is equal to the Edison for weight for equal capacity and occupies 60 per cent. less space and costs only about one-half of the Edison battery. So that really, when it comes down to the present basis for renewing the plates there is not so much gained on his proposition.

Mr. A. H. Halloran: The inference at present is, then, that nothing is as good as the lead cell. There are many inventors at work on the idea of making a storage battery of light weight and so compact that it will take even less space than the present battery. Without entering into any further discussion I think the success of the electric automobile will be greater when a lighter storage battery has been developed, but it will be a matter of time before that takes place.

Mr. G. R. Murphy: With the exception of possibly one cell, the Edison cell, nearly all the batteries in the world today are the lead, lead peroxide, and nothing today has been found either by the manufacturers in this country or on the other

side that is better. The improvement being made today is more in the perfection of the plate itself; in other words, the plate itself has been made for some time along the same general lines, but the improvements have been in perfecting the material itself. Naturally, all the manufacturers would use any other element that would produce the same results as lead, with less weight. With the exception of the Edison type I know of no battery today other than the lead-lead peroxide being manufactured.

Mr. A. H. Halloran: The trouble with the copper zinc battery was that it was not practical. In some way it was attempted to use the Edison-Lalande cell as a storage battery, but that has not proved satisfactory on account of its low electric motive force. But I feel confident that it will be but a comparatively few years when there will be something used that will give a lighter battery. When that is finally accomplished even the last objection, of weight, will be removed.

Mr. A. C. Downing: If you take into consideration the electric automobiles produced eleven or twelve years ago and the electric vehicle that we have today, and think that in that time there has been an increase of life and mileage of over 200 per cent, we are going at a very rapid stride as it is.

The Chairman: I would like to make the point again which I did this morning, that this increase of two to three hundred per cent. in mileage is due largely to the perfection of the running parts of the automobile and only slightly to the decrease in weight of the battery. The greatest decrease that has been made in the battery has been made just this last year. The output of the battery has been increased about 25 per cent. per unit of weight during the past year, and even in spite of that we do not notice any radical change in the electric vehicle business. It has been all due to the perfection of the tires, motors, bearings and so forth. I might add that the battery seems to be the most simple thing. The lead battery consists of peroxide as a positive, and spongy lead as a negative, and it would seem a very simple matter to combine these two in proper form, but people who have experimented with batteries have experienced all kinds of difficulties on account of the chemistry of the battery, the reactions that take place in the cell. The condition of the plate changes at every stage of the discharge. If you take the negative plate out into the air it oxides. As we select lighter metals for the elements we must increase their volume. For instance, Edison's battery, although lighter per cell, requires a larger number of cells and a larger volume, and the net weight is just about the same as in the lead cell. Therefore, the lead cell is better because there is the same energy in less space. When you get to making lightweight cells—of course, you can do that if you use a very superior quality of material, but usually the factor of safety is reduced with reduction in weight. This applies to machinery as well. Probably the machinery men here can corroborate me.

Mr. W. W. Briggs: I believe you are right there. As far as the commercial point of view is concerned, we seem to be losing track of the reasons of this gathering. I have been listening to Mr. Halloran, but we should consider the commercial end, the possibilities of enlarging the use of apparatus, assisting the central station man, the electric motor man, and along that line. I think two-thirds of the trouble with electric vehicles has been due to the way in which the matter was presented to the public in the early days of the electric vehicle business. Some few months ago I had some interesting correspondence with Mr. Eames, who was at one time handling our electric vehicle business, and I do not think there is anybody in the electric traction business that has given the matter the study that he has. In some correspondence I had with him with reference to the possibilities of electric commercial wagons he brought out several points that laymen would overlook. We have had several examples of the improper application of vehicles in this city. You probably remember in the early days the cigar dealer who bought a very heavy vehicle for an advertisement. If he had bought a two-ton vehicle instead of a seven-ton, it would have been better. All he had to have was a wagon that would carry around a sign. In this correspondence I was asked the question by a prospective customer how far an electric vehicle would go up a 15 per cent. grade. I passed that up to Mr. Eames. He said a certain size vehicle will go up a 15 per cent. grade for six miles, and if you will add up this distance of grade you will find that you have a pretty high hill.

In these days a man, in the selection of a vehicle, will guess at what he wanted. A brewer guessed he wanted a six-ton vehicle. In loading or unloading that vehicle it will take a certain time for the driver and that period of loading and unloading the car inoperative. If he got a three-ton wagon it would go over the ground faster and deliver twelve tons instead of six. In the early days these questions were not considered, and they were condemned, not because they were electric vehicles, but because they were not suited to the duty required. So the necessity exists for a careful study of the immediate needs of the man who proposes to use an electric vehicle. I suppose it will take some time to remove the bad taste in the mouths of the men that used it once. However, it can be demonstrated that the electric vehicle is the right thing, and with the batteries and motors, etc., that we have, it is something that we can make money on. So we are not going to lose anything by developing what we have, and we can hope for something better in the future.

The Chairman: Mr. Briggs' point is well taken, but the point that Mr. Downing and I wanted to make was that if people have in their minds that just about tomorrow or six months from now somebody is going to get out a battery, half the weight of the present standard battery, he is going to wait that six months to get a vehicle with that weight of battery in it. I believe all the discussion tends to show, and I know that all our experience tends to show, that no revolution in the battery business is going to happen. It has got to be a gradual evolution. If the battery that is out today will carry a vehicle say seventy miles on level road, it is all that you want one vehicle to do in one day, on one charge, about the city. And it is not a touring car; the gasoline is the touring car. I will announce now that tomorrow afternoon Mr. Harvey, who has a Babcock electric, will give a demonstration on Powell street hill. He will run his vehicle up and down as many times as anyone wishes. This demonstration is to convince a good many people in San Francisco who are not informed, that an electric vehicle will climb hills. That seems to have been the bugbear in San Francisco for a number of years.

Mr. A. E. H. Ridley: The real trouble with the earlier electric vehicles was not with the storage battery or the motor, but in the inherent trouble. The cigar wagon troubles were with the ball-bearings joining the motor with the gear on the outside to propel the vehicle, and also the small size of the hard rubber tires. They used to get into a rut and that would take the entire tire off, and there was only one place to repair it, and they were out of rubber generally. Also the ball-bearings. The batteries gave little trouble excepting the terminal connections. The connections between the cells were very badly put together; in the old times they wobbled about. The ball-bearings between the motor and the guiding gear were always breaking up, sometimes being crushed. Those were the two principal troubles. But with all those difficulties we ran that vehicle for twelve months and it did good service.

Mr. Harvey. The gentleman who spoke a while ago made a remark about the capacity of the car, that is, that it was not the fault of the electric automobile, that the man loaded it down, that he got a heavy truck to carry a certain load, but that the man got a truck that was too heavy, that he should have got a lighter truck. In selling gasoline trucks for a number of years, I think that Mr. Briggs is entirely wrong. I have sold cars here that we call thousand-pound wagons, and when we were called upon to see what was the matter we found they were trying to use it for 2,500 pounds. When we sold a 2,500-pound wagon it was expected to carry 7,500 pounds. Every time we had an accident we found that was the case. I think Mr. Briggs is entirely wrong in regard to getting over the ground faster. What he wants is a heavy truck to carry five tons that is capable of carrying 20 tons.

Mr. Briggs: I did not lay that down as an absolute rule. If you get a truck that keeps a driver going, the truck that will keep him driving most of the time, that is most efficient, but if you waste time in loading and unloading, your vehicle is inefficient. The rule has to be modified to suit a man's particular requirements. My idea is the need of careful study of a man's actual conditions. If a man is going to handle heavy machinery he should have a heavy truck, but if a man is going to handle empty cigar boxes he would have a hard time in getting a big load. The application of a man's trucks should be made to a man's need, and not the man's needs to the truck. There is no question as to the need of having a heavy truck to handle heavy pieces.

Mr. W. L. Harvey: A drygoods firm that will buy a thousand-pound wagon and never has before handled more than a thousand pounds, if he has an automobile will get twenty-five hundred pounds on it. If you take a horse and buggy, the statistics of the United States show that the ordinary radius of a horse is fifteen miles per day. With our electric machines it is thirty to fifty miles a day. We go to a man and we say, "We can take and put you in a machine that will deliver a certain amount of goods in a given time that two horses driven single will do." Immediately that should convince him of the fact. He says, "If you will agree to furnish what two horses will do," and he immediately piles up what four horses will do. That is what we have been up against all along. Take the Emporium and Roos Brothers. Roos Brothers are the only firm that acknowledges positively and actually that they put out

four horses with a single machine. A single machine did all their work on Saturdays which five horses used to do. They had the sense to employ a good man to drive that machine. The result was that we got good benefit from that. Then we went to the Emporium, and they wanted to get a boy to drive the machine, where it takes a first-class machinist to do it. And with the electric vehicles we are going to find the same experience. When we tell a man we are going to give him a vehicle for 500 pounds and then give him a 2,500-pound machine, we will meet the objections.

The Chairman: We are getting off the subject of batteries. We will be glad to hear of your troubles with batteries.

Mr. I. G. Perrin: While on this particular subject I wish to agree with Mr. Harvey in the respect that trucks are almost always overloaded. One point not touched upon is that nearly half the time these trucks are running empty, and I believe consideration should be given to the fact that two-thirds of the expense occurs with the car running empty. That is the reason that the smaller truck works out to be more efficient than the larger ones.

The Chairman: If there is nothing more to be said on batteries we will go to the next paper.

Mr. C. O. Wilson: There is one objection to electric vehicles and that is the washing of the batteries. A great many people, when you tell them how often the battery has to be washed, seem to think that is a great expense when you tell them what it is going to be; and I would like to ask if there has ever been any work along the line of doing away with washing so often as is at present necessary. Should you wash a battery two or three times depending on how it has been used? There are a great many people who object to that. It probably lays up the vehicle for a couple of days, if you did not happen to have a fair battery; and a great many of the doctors and business men need the machine right straight along, and it throws them back a great deal. What I would like to know is if there has been any work along the line of doing away with this washing. Did not the Willard people put a sort of rubber around the plates to keep the material from depositing in the bottom of the jar to prevent the necessity for washing?

The Chairman: The Sperry people had an envelope, but it stopped the circulation of the electrolyte next to the plate. Mr. Stevenson, you can tell us something about washing batteries and how long it takes to wash them.

Mr. P. M. Stevenson: I do not feel very much like talking, but I am willing to answer any questions. I have handled a good many batteries in seven years, vehicle batteries especially. In washing batteries I do not think it takes very long—two days. There are other things that tie a car up longer than that. I have about sixty to take care of and I never have any objection about the battery washing in any way. Some people do kick a little about the expense, but it is not great in comparison with other things.

The Chairman: Of what does the expense consist—in the time and labor?

Mr. P. M. Stevenson: It is mostly labor, where you are using the old separators and electrolyte.

Mr. G. R. Murphy: Have you a flat charge for washing?

Mr. P. M. Stevenson: Yes, about 90 cents a cell and material extra. That is for labor, 90 cents a cell.

Mr. G. A. McDougald: Does that include the labor of washing the cells?

Mr. P. M. Stevenson: Yes. The total runs up to a little more than a dollar a cell, putting in new electrolyte and separators.

Mr. G. R. Murphy: Are there not some people in Los Angeles who make a flat charge?

Mr. P. M. Stevenson: Yes, I think so. They charge a dollar a cell; but then you do not get a very good job.

Mr. G. R. Murphy: Did they not make a flat charge of twenty-five dollars for thirty cells?

Mr. P. M. Stevenson: I have not heard of any. There are people who make a flat charge, but I have seen several that have been washed that way, and they have always been slighted.

Mr. W. W. Briggs: About how often does that washing have to be done?

Mr. P. M. Stevenson: I find that we get on an average about three thousand miles on one washing. We get as high as eight to nine thousand miles out of the battery, and we wash it usually three times.

Mr. G. R. Murphy: At the end of about each three thousand miles?

Mr. P. M. Stevenson: The battery will only stand two washings. It runs until it gets dirty the third time, when it will hardly pay to wash again.

Mr. G. A. McDougald: What kind of skilled labor does it take to do that, for the labor of washing them out and burning the connections?

Mr. P. M. Stevenson: It does not take much skilled labor, one man who understands the business. It is simply directing. A man needs just a little instructing. Burning needs some practice, but almost any man can do the other work.

Mr. G. R. Murphy: Eight or nine thousand miles is as much as you obtain from a set of positives.

Mr. P. M. Stevenson: We never set up a negative after eight thousand miles. The negatives give out before the second set of positives do. We have had cases where a battery has not been used properly where the positive plates would give out at about 5,000 miles. Then we would use the old negatives and we would probably get 5,000 more.

Mr. W. W. Briggs: Is there any value in a discarded plate?

Mr. P. M. Stevenson: You would have to ask the electric storage battery people about that?

Mr. G. J. Brand: Can the old plates which are thrown out be used over again? Can they be made use of by putting in new active material?

Mr. G. R. Murphy: No, that is not feasible. It has never been a success. It is far easier to put in a new plate.

Mr. G. A. MacDougald: How often do the separators have to be changed, Mr. Stevenson?

Mr. P. M. Stevenson: I find it is better to change them every time they are washed. I have washed batteries where I would leave in the old wood separators, but trouble would always come from it.

Mr. W. D. Vance: From the breaking up of the separator?

Mr. P. M. Stevenson: Yes, usually that way. In disturbing them they would get broken. I would not have to replace all of them, but you have to be very careful, and I find it better to replace them.

Mr. W. D. Vance: Do you find it necessary to take the positive and negative elements apart?

Mr. P. M. Stevenson: I do not always remove them if they have not been damaged in any way. I get a good many batteries that people charge themselves, and I find that you have to have new separators if you get a good job out of it.

Mr. W. D. Vance: Did you ever run into a set of separators that have been punctured, apparently burned through?

Mr. P. M. Stevenson: I have found several that way. A good many times I have found a small piece of lead packed in with the separator which caused a short circuit that burned out the separator.

Mr. W. D. Vance: I had a case where every separator was punctured through in several places. It looked very much like the hole that a static discharge would make, and I never could understand what the trouble was.

Mr. G. R. Murphy: I have never seen that case. Was there any rubber separator used?

Mr. W. D. Vance: No, there was no rubber.

Mr. G. R. Murphy: That might possibly be it. It might have been pressed up against the positive plate. For that reason they use the perforated rubber sheet as a protection to keep the wood separator away from the surface. It is not so necessary in a smaller battery.

Mr. G. J. Brand: What is the objection to all-rubber separators?

Mr. G. R. Murphy: The objection against all-rubber separators is the fact that they have to be perforated, and as the material is washed out it is bound to lodge in those perforations and bridge across. The wood separator does away with all troubles of this character.

Mr. G. J. Brand: I found one mechanical trouble, that the separator had not been made to fit just right.

Mr. G. R. Murphy: We have had a little trouble of that kind in sparking batteries that was due to the separators not being of sufficient thickness for the separation of the plates. That has been remedied. I do not think you will have any more trouble of that character.

The Chairman: In going about I have had different people tell me of many different lengths of time that it takes to wash a battery, and they state all the way from two days down to less than half a day. I was told in Long Beach that they could take in a vehicle, wash the battery and send it out inside of half a day. I want to know if there is anyone here who can do that?

Mr. P. M. Stevenson: I know just how they do that. They will pull out the elements, wash out the jars, fill them up again, and burn them together and slide them right back in the rig without examining them, charging a flat rate of so much a cell.

The Chairman: They do not take the plates apart?

Mr. P. M. Stevenson: No.

The Chairman: In that way they do not have to remove the separators?

Mr. P. M. Stevenson: No; they simply wash out the jars.

The Chairman: They simply remove the sediment from the bottom of the jars.

Mr. Brand: There is really no value in it. The plates might not have time to discharge, but they cannot very well use the same electrolyte.

The Chairman: Mr. Perrin, how long does it take you to clean a battery under the best conditions?

Mr. I. G. Perrin: I have always been under the impression that it was very advisable, in fact, quite necessary, to give the battery one slow discharge and possibly two discharges to bring it up after the elements have been exposed to the air, but I would like to have an expression from Mr. Murphy in regard to the first washing, where the washing of the battery is done by just simply taking the elements out and dumping the sediment and not disturbing the elements or the wood separators. That is, on the first washing, and I want to know if I am correct in thinking that the life of the negative plate would be twice or nearly twice the length of the life of the positive plate.

Mr G. R. Murphy: In regard to the washing, I think I agree with Mr. Stevenson. It is simply a question of how you want to do it. I do not think in the first place that a good job can be done reasonably in less than a day. That is the minimum, and it is pretty fast work, it would take nearer a day and a half to do the work properly. The proper way to wash a battery is first to charge the battery up, and on removing the elements from the jars it is simply a question of your own judgment, that is, how the separators look. If there is any mechanical damage to a separator I would say put in a new separator right away and not run any chance of having a bad cell later on. It also depends, I think, on the rig, whether there would be any mechanical injury to those separators. If you have a rig that is not an easy running machine there might be some tendency to damage or split them. I do not think it is necessary to remove all the separators, but I think you will find always that a small percentage needs renewal or fixing up. After cleaning, the amount of charge that is necessary depends on the method in which the work has been handled. If your negatives are kept reasonably wet an ordinary charge would do. If there has been any tendency to dry out, then I think a longer charge is necessary, and it might be well to follow this up by a discharge for capacity. Ordinarily, if the negatives are kept reasonably wet I do not think that discharging is necessary. As far as the life of the negative plate is concerned, it is pretty hard to say what it is in miles. And it is pretty hard to compare it with the positive plate. The life of the positive, in the first place, is a function of the number of the charges. A positive plate is good for 300 charges. If you get an ordinary life out of a set of positives —that is 300 charges—I think your negatives will be good for one and a half to one and two-thirds of the life of your positives. The whole thing comes down to a personal equasion of just how it is handled. Mr. Stevenson brought up the point that in their garage they preferred to put in a new negative at the end of the first set of positives rather than to interfere with the working of the second set of positives at some midway point in their life. Of course, you could work that negative material to a greater extent, possibly 60 per cent. I think that answers your question.

Mr. I. G. Perrin: I think it does. If reasonably sure of the set of positives throwing the whole thing out of balance, unless one is reasonably sure of working out two sets of positives.

Mr. G. R. Murphy: The bad feature of putting in new negatives too soon is that you do not work out your investment, and on the other hand you have to give them a full initial charge with positives partially worn. That is not true of positives. Still, that condition could be done away with if you happen to have an old set of grids about, charging up the negatives with them. That is a condition that could be easily met.

The Chairman: These methods come down to a question of practicability. The battery man naturally runs everything—the vehicle and his customer—to fit the battery, whereas the customer makes the battery run to fit his desire. We find this obtains not only in the vehicle business, but in the central station business, and the practical solution is, I believe, to make the renewals of the battery, the washings and the repairs of the vehicle conform to the desires of the user and make the vehicle the most convenient thing for him.

Mr. G. R. Murphy: I would like to ask Mr. Stevenson, in washing a cell, what does he pay for lead burners? What is the difference between Los Angeles and San Francisco?

Mr. P. M. Stevenson: Just working at that trade alone, fifteen to eighteen dollars per week. Very few of them do it for much less than that. What you would call an excellent lead burner. I do nearly all the lead burning myself.

Mr. G. R. Murphy. Can you get men?

Mr. P. M. Stevenson: There are a few, but as a rule, if they can do that they do not want to do anything else.

I was going to say something about batteries. Some manufacturers of electric vehicles do poor burning of battery connections, causing plates in certain cells to deteriorate rapidly. In talking about washing the battery, the battery should be taken down when washed the first time, because you will find several defects like that. We have had such things as even reversed cells come in a new battery that is supposed to have been tested.

Mr. Seraba: I would like to say that I think a man that has got a discarded cell has got to look at the washing and renewal business in a little different light than the man in the shop. I think the first washing can be done and at a small profit at a whole lot less than 90 cents a cell. I think it can be done on a new battery—well, for a 24-cell battery, for ten dollars easily. I am saying this because when you sell a man you have got to tell him approximately what it is going to cost him. As far as renewing the positive at the same time that you renew the negative, because a negative will not outlast two positives, I do not see the point. For instance, if you put in a new set of positives you have got to open the batteries three times for washing, and at the second washing I do not see why you cannot put in new positives at that time. You have got to keep the proposition on as economical a basis as possible. I think those who are selling cars have to consider this point rather than try to keep the cars running up to their full capacity at all times.

Mr. W. L. Harvey: The oldest storage battery that I have ever heard of is one that is contained in the human breast. It is called the heart. We have mechanics called doctors. In due time the human electric automobile begins to show the effect of wear and tear. The battery needs washing. The quack gives you a dose of calomel and turns you loose. In two or three weeks you are again run down, and commercially speaking the human heart is not for sale. The commercial vehicle is called the electric automobile—the heart of the automobile is the battery. The ordinary man who will take the battery from the machine and half wash it, just give it an overlook and put it back is a quack. The man who is selling that machine and to influence his sale insists that his machine can be taken care of so much cheaper than the other man's car, simply because his battery does not have to be taken care of, is also a quack. There is only one way to look at the proposition. We are selling electric automobiles as a commercial commodity; we are selling them to make money; and when we sell a man a machine we want to be able to look him in the eyes the next day or six months afterwards and be glad to meet him, and not run around the corner and dodge him because we have given him a gold brick. The man who sells an automobile has a certain moral obligation put upon him. That man must explain to the customer who buys that his battery has certain deficiencies; it must be looked after; it must be washed; and in putting in the initial charge after the washing it takes a certain time to do it. I used to engage a horse and buggy by the month in my business, and when my horse was sick I would go down to the stable and raise the dickens. I found I could take the street car for a day or two until that horse was put in proper condition. With the automobile it is the same, your customer is the same as I was; after he buys an automobile he could not get along twelve hours without that machine, he has got to have it. It is up to you, gentlemen, to tell him that he cannot have it until it is properly fixed. The great trouble with the electric automobile is that you are trying to turn them out too quick, you did not half fix it—you are quacks. When you sell a machine explain to the man that the heart of the machine is the battery; the battery has to be properly taken care of, and at certain periods you have got to have that battery in your place and it is going to take time. Impress it on his mind and he will know it. He will kick when you have to fix it, but when you have fixed it properly and turned it out that way he will be a friend of yours for life. But if you take a hurry-up job from him and wash it in six hours or twelve hours you might as well stop doing business, because you are going to invite trouble for yourself. After it has been washed a battery is like a new machine, it has got to have the same initial charge; it has got to be charged and then drawn out, you have got to do it with proper amperage; it has got to be done properly or you will have the machine back on your hands. You have to educate your customers that at certain periods you have to do that, and you have to do it right. If you do not you are going to have a continual run of kicking. Everybody will have a hammer out for the electric automobile. I believe that every one of them is properly built; every one of them can be made to run its full guaranteed distance every day. It is just simply a matter of taking care of the battery. And when everybody makes up his mind that such things have to be you are going to have pleasure in selling electric automobiles, and you are going to make friends of those you sell them to. (Applause.)

Mr. A. C. Downing: Following up what has been said:

The best example that has come under my notice of such work is that done by Atwood, of Toledo, Ohio. Mr. Atwood appreciated the point Mr. Harvey has made after knocking around the country for several years fixing up troubles with storage batteries and decided he would open an ideal garage in a city. He selected Toledo. There were not, at the time he went there, twenty-five electric machines. In his selling program he outlined (just as has been suggested) to the customer what a battery needed, and he went one step further: He had an extra battery, and whenever a man's battery needed washing he loaned him that extra battery at a nominal charge, say a dollar a day for the time his battery was laid up. As a natural consequence, he could have proper time for giving the customers' battery proper attention. That is one of his strongest points—his customers would have the use of the car every day.

Mr. W. D. Vance: I want to say in justice to myself—I do not know whether Mr. Harvey referred to me.

Mr. W. L. Harvey: No, no.

Mr. W. D. Vance: My point was not to slight the work. My point was to evade the point that the gasoline people make to everybody that has a car in the shop to fix.

Mr. W. L. Harvey: You mean to make a flat price for a certain job?

Mr. W. D. Vance: No, charge a fair price for a fair job.

The Chairman: I think we understand the points that are made, that the salesman often tries to cover up the weak points, and when the customer finds them out he is dissatisfied, whereas, the long-sighted salesman gives a full account of what he is selling, and the result is satisfactory.

(To Be Continued.)

AMERICAN AUTOMOBILES IN SPAIN.

Consul-General Frank D. Hill of Barcelona, in writing on the automobile trade in Spain, states that he is in receipt of a report, made at his request by the agent of an American automobile manufacturer, in which the writer states:

An experience of several years' duration as manager of an important garage in Mexico, during which time he had ample opportunity to study American cars, has convinced him of their superiority over European cars in general.

In the first place the American car is carefully designed for travel over poor roads, many of those in Spain being in a deplorable condition. The American chassis is wonderfully strong, of great resistance, and high enough to permit passing over stones projecting eight or nine inches. As a rule European cars are built very low, the tendency being to increase the stability in this manner. The hang of the American car is superb, incomparably superior to that of the European, and in addition to numerous other advantages it possesses the most appreciable one of cheapness.

The cost of an American car is, in proportion, greatly inferior to that of any European make. For example, an average American car, 30/32 horsepower, equivalent to a French 16/20, with double phaeton tonneau, searchlight, lanterns, horn, cushions, hood, etc., well appointed in every respect, costs $2,800; while the French car 16/20 costs $3,184, leaving a difference of approximately $400 in favor of the American car. To this should be added the 20 per cent discount granted by American manufacturers, with the result that the net price of a completely equipped car is $2,240. Of course, freight charges and customs duties increase the prices shown, but these are practically the same for European as for American cars.

The American cars best adapted to conditions in Spain are first-class makes, ranging from 40 to 65 horsepower, and costing from $4,000 to $5,000; second class, small touring cars of 20 to 40 horsepower, ranging in price from $1,500 to $3,000; and runabouts for business men, doctors, brokers, agents, etc., at a cost of $850 to $1,000. These little cars present great advantages for Spain, being convenient, inexpensive, easy to run, and good hill climbers.

Excellent opportunities are offered to American makers of tires and accessories, owing to the good quality and cheapness of their products.

A set of American tires was tried in Barcelona and lasted exactly one year, in spite of continuous daily use on a car weighing 1,600 kilos (3,520 pounds). It is difficult to cite a similar example. Aside from their cheapness, accessories of American manufacture are to be recommended for their perfection and convenience, American makers progressing rapidly in this branch.

Drays and trucks for commercial use are almost unknown in Spain, and their introduction would undoubtedly be facilitated by familiarity with American systems, which are much cheaper than those imported from France or manufactured here.

Should American manufacturers care to exploit an excellent market, they ought to organize a permanent exposition in Barcelona. A stock of most improved models should be kept on hand, supplemented by tires and accessories of every description.

NEW AUTOMOBILE TRANSPORTATION COMPANY IN TOKYO.

Vice-Consul-General E. G. Babbitt of Yokohama forwards the following information regarding the organization of an automobile transportation company in Japan:

There was recently organized in Tokyo a transportation company for the purpose of transporting passengers and freight throughout that city. The capital of the company is 500,000 yens (yen = $0.498 gold), of which one-fourth has been paid in.

The intention was to start business with 20 motor cars, and a number of these have been ordered from France through a local business house. It is understood that a firm in Paris is supplying the cars, at an average cost of $3,000 gold. Five of these cars have recently arrived and undergone successful tests; two of them are for passengers, carrying six persons each, and the others light-delivery trucks of a loading capacity of 1½ tons.

Transportation of goods by automobile is a comparatively new undertaking for Tokyo. Several of these light-delivery trucks and vans have been used in Tokyo by private companies, but the fact that no orders were repeated is evidence that they were not considered economical or capable of competing with the cheap cooly labor that so largely takes the place of horse or mechanical transportation in Japan.

American manufacturers should not become possessed with the idea that they can send catalogues over here and receive orders and remittances by return mail; the Japanese want to see what they are buying. It appears that the present undertaking is rather a venture on the part of the French manufacturers and the local agent; that the success of the new transportation company is problematical; and that the cost of the machines, with 50 per cent ad valorem duty, with cost of operating and repairs, may take more than the profits of a business which is not assured them.

MEXICAN PRODUCER PLANTS.

The general adoption of producer gas in Mexican mining operations is well illustrated by the plant of the Capuzaya Mining Company; Parral, Mexico. Here a 300-horsepower Westinghouse gas engine generating unit was put in operation in February of the present year, operating on power gas generated from charcoal. This plant was installed to serve a large group of mining properties at Parral. This company has had a Westinghouse engine of the same size and design in operation for about a year. The National Iron & Steel Company, Mexico City, has also operated a producer gas engine plant for light and power service, and the Cia Industrial Jabonera, at Laguna, Mexico, installed a similar plant in 1906. Another important plant in Mexican territory may be mentioned, that of the Potosina Electric Company, San Luis Potosi, Mexico. This was one of the earliest and the largest installations in this part of the country, the first engines being installed in 1902. Another is that of the Empress Electricita Duraguena, Durango, Mexico, in whose plant is installed 320 horse power in suction producer.

CURRENT COMMENT

Competitive stoke-room firing reduced coal consumption 20% on some of the vessels of the U. S. fleet in its recent trip around the globe.

The largest hydro-electric plant in France is at the Tuilleries works, ten miles from Bergerac, which has been designed to develop 23,000 horsepower.

Vanadium bronze, on account of its non-magnetic properties, is to be used in the construction of the new magnetic survey yacht for the Carnegie Institute of Washington.

An alloy cannot be made with aluminum and sodium, as the sodium remains at the top and the aluminum at the bottom of a mixture. Nor will thallium, lead and bismuth mix.

Coal in Japan is obtained chiefly from Kiushiu, the southernmost of the islands, and from Hokkaido, the most northern. The former produces two-thirds of the entire output of Japan.

Heroult electric furnaces are being built for the South Chicago works of the Illinois Steel Company and the Worcester plant of the American Steel and Wire Company, both being 15-ton furnaces. These are to refine the steel by eliminating phosphorus, sulphur and slag.

"Krytol," for use in electric furnaces, is a patented compound of graphite, coke and carborundum, put up in uniformly sized grains. Resistance is increased by increasing the proportion of coke and carborundum. It is used either loose or in glass tubes for the production of steady low temperatures.

Electric welding is being largely used in the manufacture of chains, the electric machine being able to weld from four to five hundred links per hour for small chains, formerly done at the rate of twenty per hour by hand. Iron to be welded electrically must be free from phosphorus and silica and contain manganese.

Electrical Sterilization of water is under experiment for the water supply of Paris. Ozonized air is forced into sterilizing columns by means of an electric pump. The process removes practically all the colon bacilli from turbid river water, previously filtered through sand filters. It requires 10,600 kw.-hr. per million gallons of filtered water and 12,490 kw.-hr. per million gallons of turbid water.

The Stassano electric furnace has replaced the crucible in the manufacture of steel at the Bonner Fraserfabrik, Germany. There are two one-ton furnaces in the plant, each of 250-horsepower, one being kept in reserve. They employ three-phase current at 110 volts 50 cycles. The treatment of a one-ton charge takes five hours, including 1½ hours for de-phosphorizing and de-sulphurizing. The current consumption is 900 kw.-hrs. per ton.

An anti-smoke campaign has been instituted by the Pennsylvania Railroad among its engineers and firemen, in a general order issued recently to all lines east of Pittsburg, to the effect that "smoke means waste and must be avoided." Five assistant road foremen are instructing firemen how to reduce the quantity of smoke. The coal bill of this road is $10,000,000 annually, and it is believed that $100,000 could be saved every year with more economical handling of coal.

A new source for rubber has been found in a plant in Portuguese West Africa, the roots of which contain rubber-yielding latex. The roots are chopped into pieces and are then subjected to pressure. From this liquid the rubber is prepared by heating or exposure to the air. The plant is locally known as "bitinga." Experiments are being made to see if it is likely to pay for cultivation.

Electric pumping and hoisting is to be installed at the Old Dominion copper mines at Globe, Ariz. The power plant will be placed in the smelter power house and have a capacity of 2,000 kilowatts.

Electric automobiles in the Glidden tour for 1909 are planned as the result of a 2140-mile trip between Lincoln, Nebraska, and New York City recently made by O. P. Fritchlie in a Fritchlie machine. The machine averaged ninety miles a day over bad roads.

High tension bronzes, such as manganese bronze, on account of their tensile strength and elongation, which approximates that of steel castings, are excellent for high pressure marine boilers. These qualities continue even at the high temperature here attained. For valve fittings there is no trouble with liquidation, as in the case of gun metal castings.

The photo-electric cell is a new form of dry battery, theoretically interesting but of little practical value at present. Dr. J. A. Fleming describes such a cell in a recent paper in the Philosophical Magazine. It consists essentially of a glass tube from which the air has been exhausted and having a strip of platinum at one end and a plate of fluid amalgam of sodium and potassium at the other. When a powerful light is concentrated on the latter an electric current flows from the platinum to the amalgam through the vacuum tube. This current is at a potential of one-half volt and amounts to about five micro-amperes. The light frees negative ions from the alloy which liberate their electric charge upon striking the platinum. This produces a positive electric current in an outside circuit. This is probably the basis of certain sensational articles in the daily press.

THE JOHN W. MACKAY JUNIOR FELLOWSHIPS

In July, 1906, Mr. Clarence W. Mackay, jointly with his mother, Mrs. John W. Mackay, gave to the University of California one hundred thousand dollars, for the endowment of the John W. Mackay Junior Professorship of Electrical Engineering, with the proviso that such part of the income as the Regents of the University might determine, or the whole, was to be used for the salary of the incumbent of the chair, and that the residue of the income was to be devoted to the furtherance of research work in electrical engineering in the University.

In accordance with the terms of this endowment the University of California has established two *John W. Mackay Junior Fellowships in Electrical Engineering*, of an annual value of six hundred dollars each. The tuition charges of the University are nominal. These fellowships are open to all properly qualified university graduates.

The object of the fellowships is not to facilitate ordinary engineering or scientific study, but to enable students who have completed a college course to do research work in electrical engineering, with a view to aiding the advance of the application of electricity to scientific and industrial purposes.

The place of residence of those holding the fellowships is to be at the University of California. Experimental or other work, however, may be carried on outside the laboratories of the University.

Opportunities for study and investigation in Electrical Engineering at the University of California are extensive, and the laboratories are well equipped for investigation and research work. The appointment to each fellowship shall be for one year, which appointment may, however, be renewed, at the discretion of the Graduate Council of the University.

Applications for these fellowships should be filed with the Recorder of the Faculties, Berkeley, Cal., as early as March 15th, if possible.

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FOUNDED 1887 AS THE
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CONTENTS

Pulverized Coal

For years "slimes" caused as much trouble in cyaniding gold ore as did "fines" in the burning of coal. The cyaniding problem was finally solved by crushing the ore in a tube mill until it was all converted into "slimes." An analagous solution has proved successful in the problem of burning fine coal by first pulverizing it so as to properly prepare it for combustion. Much of the Portland cement in this country is burned with pulverized coal, and it is also fast finding its way into other industrial and metallurgical establishments.

Powdered coal has several advantages, including complete combustion, minimum ash and high temperature. The coal is first crushed, then dried and finally pulverized, so as to pass a hundred mesh screen. The firing is accomplished much as with crude oil, the object being to get a good mixture of coal and air. The latter is furnished under pressure, and the coal dust is supplied to an injector by a screw conveyor. It is interesting to see how the same treatment has overcome the difficulty in two instances apparently so different. In competition with oil or natural gas, it is not feasible, but where there is abundance of low grade coal, this is one of the best methods of consuming it.

Limitations of Low Head Water Power

There is much talk of the possibilities of the development of electric power from the extremely low heads available in large rivers. It is argued that although many of the high head water powers have already been utilized, there is yet abundant power available in other streams. Investigation shows that there are two considerations that limit this Utopian dream.

With a head of twenty feet, or less, the speed of a turbine is so low that the generator to which it is connected must be so large and have so many poles, that it becomes not only mechanically undesirable, but also economically impracticable. Its cost is excessive. Indirect drive by gear, rope or belt introduce complications which so increase the cost that the development of low head water power is profitable only where electricity commands a high price.

The second reason is one of safety. Most streams are subject to floods, and as a matter of precaution a power plant should be placed well above high water mark, which greatly reduces its effective head. This is exemplified by the plant on the Willamette River, in Oregon, whose output is materially curtailed during periods of high water.

When a low head is to be utilized a reaction turbine is employed, because its speed is approximately that of the water flowing through it, while the speed of an impulse wheel is but one-half that of the water. It is for this reason that the impulse turbine only is advisable for a very high head where the reaction type would give too high a head.

One of the most interesting low head installations

in the world is that nearing completion at McCall's Ferry on the Susquehanna River in Pennsylvania. Here one hundred and thirty-five thousand horsepower is to be generated by ten turbines under a head of fifty-three feet at ninety-four revolutions per minute. Each of the generators weighs almost three hundred million pounds. These same generators would develop three times as much power, if used under the head available at Niagara Falls, and ten times as much if under that at Centerville, California. If they were used at the extremely low head under discussion, they would develop less than half the horsepower. This plant is in the midst of a region of cheap fuel, and is to furnish electricity in competition with that developed by steam power, and therefore stands as an example of what can be accomplished at a moderately low head, and also shows how unwieldly a generator might become under a very low head. Under present conditions we can hope for but little power from streams running through a country of low relief.

BOOKS RECEIVED.

"General Lectures on Electrical Engineering," by Charles P. Steinmetz, A. M., Ph. D., edited by J. L. R. Hayden, 284 pages, 6x9, cloth, gilt top, hand tinted portrait, 48 diagrams. Price $2.00 postpaid. Robson & Adee, Schenectady, N. Y., and Technical Book Shop, San Francisco.

This attractive volume brings into compact form a number of lectures, general in character, describing some perplexing problems in electrical engineering. By eliminating the calculus from his discussions the author has removed the usual stumbling block to a clear comprehension of this subject by those not expert in "mathematical shorthand." This book is not an elementary treatise. It presupposes a knowledge of all ordinary electrical terms and a familiarity with electrical apparatus. Each lecture is a unit in itself, yet all are connected by a logical sequence. After an introductory review of the requirements of the various applications of electric power and a discussion of the kind of electric current best fitted therefor the author first takes up the distribution of light and power by direct and alternating current, together with load factor and the cost. He next treats the subject of long-distance transmission, frequencies, voltages and losses, including transformer connections. Higher harmonics of the generator wave and high frequency oscillations and surges are each the subject of a lecture. Under generation a comparison of prime movers is made and the different needs of each class of service broadly discussed. Succeeding lectures deal with the hunting of synchronous machines, regulation and control, and lightning protection. About fifty pages are devoted to three lectures on the electric railway, its train and motor characteristics, particularly those of the alternating current railway motor. A lecture is devoted to electrochemistry, one to incandescent lamps, and one to arc lighting. The volume is concluded with an appendix on light and illumination and one on lightning and lightning protection. Diagrams have been introduced frequently to supplement the text. In the conrse of the preface it is stated that this book "comprises a discussion of the different methods of application of electric energy, the means and apparatus available, the different methods of carrying ont the purpose, and the relative advantages and disadvantages of the different methods and apparatus which determine their choice." Coming from such an authority and presented in such an admirable form, this is a volume that is worthy of a place in the library of every electrical engineer. Its chief defect is the absence of an index, which would greatly enhance its utility. A cursory examination indicates several typographical errors which will undoubtedly be corrected in future editions. With so much to praise and so little to condemn, the book is a most valuable contribution to the classics of electrical engineering.

PERSONAL.

George Curtis of the Waterman, Davis & Curtis Co., electrical contractors of Sacramento, was in San Francisco this week with his wife.

J. W. Perry, of the New York office of the H. W. Johns-Manville Company, is in San Francisco in the conrse of his annual trip to the Pacifiic Coast.

Thomas I. Stacey, treasurer of the Electric Appliance Company of Chicago, accompanied by his wife, left San Francisco this week for Los Angeles.

H. M. Lauritzen, recently with the sales department of the New York office of the Holophone Company, has joined the San Francisco force of the same company.

G. A. Scoville, Pacific manager for the Dean Electric Company, of Elyria, Ohio, has returned to San Francisco after a business trip of about a week in the South.

J. E. Way, of the R. Thomas & Sons Company, East Liverpool, Ohio, who has been in the Northwest, has been compelled to abandon the balance of his Coast trip and return to the East owing to the sudden death of his father-in-law. Mr. Way is planning to return to the Coast at an early date and complete his trip, which will include San Francisco and Los Angeles.

TRADE CATALOGUES.

The General Electric Company in Bulletin No. 4646 presents interesting data relative to the quality of light produced by tungsten lamps, simplicity of construction, adaptability to both alternating and direct current circuits, and various other data relative to life and economy.

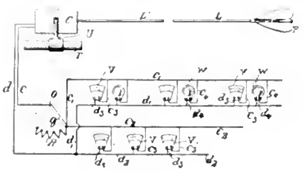
In Bulletin No. 4649, just issued by the General Electric Company, the relative advantages and disadvantages of "Independent Drive" and "Group Drive" of machine tools are demonstrated. While the title of the bulletin refers to Railroad Shops, the data are applicable to machine shops in general.

A list of engine type direct current generators sold by the Crocker-Wheeler Company, Ampere, N. J., is given in their Bulletin No. 110. This list, covering fifteen pages, gives the names and addresses of companies and individuals using these generators. Industrial plants, street railways, railroad and other machine shops, office buildings, stores, schools and residences are included in the list. In several items no address is given, these being United States battleships, several of which are equipped with Crocker-Wheeler generators.

The ease with which the Tungsten lamp is adapted to street lighting is shown in Bulletin No. 4647, just issued by the General Electric Company. There is no lamp of small or moderately large units of light that is as economical as the Tungsten series lamp, and it is, therefore, ideal for suburban and residential street lighting. Inasmuch as the high current lamps are just as efficient as those for low current, the Tungsten series lamp can be used in conjunction with series arc lamps without the necessity of having two circuits. The bulletin contains curves showing candle-power distribution of this lamp under different conditions, illustrations of constant current transformers and series lamp socket used in connection with the lamp, and several diagrams showing the advantages to be derived from the use of the Tungsten lamp for series street lighting.

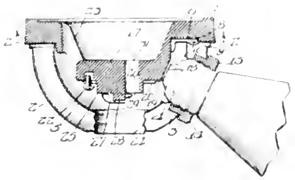
PATENTS

912,291. Electric Log. John H. Cuntz, Hoboken, N. J. A ship's log including a casing adapted to be supported on or from a ship's rail, electric generating means in said casing, mechanism connected with said generating means, a log line



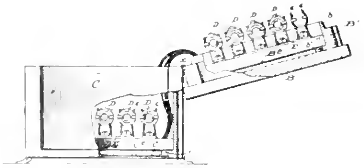
attached to said mechanism and extending to a propeller, a propeller, speed indicators on the ship separate from said casing, and electrical connections from said indicators to the mechanism in said case.

912,529. Plural Lamp Socket. Reuben B. Benjamin, Chicago, Ill., assignor to Benjamin Electric Manufacturing Company, Chicago, Ill. In a cluster or plural lamp socket, a suitable basic or supporting part, lamp supporting means detachably connected with said basic or supporting part, a



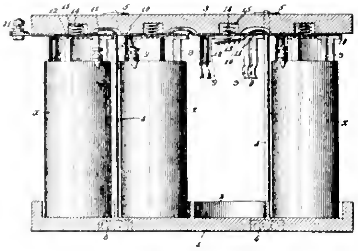
circular metallic casing having lamp openings carried by said lamp supporting means, registering center contacts suitably inclosed by said casing, and binding posts suitably disposed within said casing and adapted to be disclosed by the detachment of said casing and lamp supporting means.

912,871. Controller for Electric Motors. Robert L. Munson, Seattle, Wash. A controller box having a hinged cover and provided with parallel series of spring socket clips, one



series of clips being carried by said cover, and detachable resistance coils mounted in said socket clips parallel to the hinged cover and arranged to be exposed by turning back the cover.

912,705. Battery Holder. Charles T. Mason, Sumter, S. C. A battery holder for electric cells, comprising frame or support, and a series of cell connectors carried thereby, each of said connectors including an annular conductor plate having



a series of cell engaging spring fingers projecting therefrom, and a resilient integrally formed tongue the outer end of which extends into and lies within the open center of the next successive conductor plate.

912,946. Dry Battery Cell. George N. Eastman, Riverside, Cal. The method of making dry batteries which consists in winding a sheet metal electrode into tubular form, incasing

said electrode with a self adhering fibrous material, closing one end of said tube, introducing the excitant filling and electrode and sealing the tube.

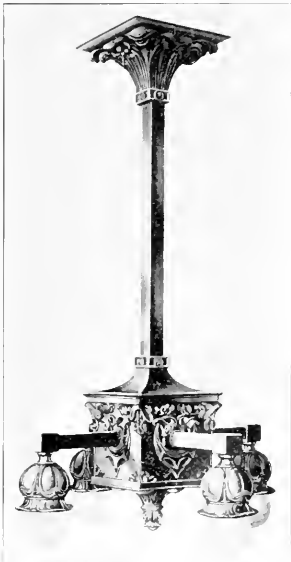
912,554. Artificial Fuel. Ira Foreman and John L. Thornton, Los Angeles, Cal., assignors to Pressed Wood Co., Los Angeles, Cal. The herein described method of manufacturing

artificial fuel which consists in providing a fibre core under tension and packing around and bonding to such fibre core planing mill shavings under pressure of 250 pounds to the square inch.

INDUSTRIAL

WESTINGHOUSE-NERNST CHANDELIERS.

Since the new Westinghouse-Nernst chandeliers were put on the market several attractive variations of the original designs have been added to the list. One of the most pleasing is the square art nouveau cast chandelier shown in the accompanying illustration. It is slightly more massive than the other designs and its ornamental treatment is somewhat



Westinghouse-Nernst Chandeliers.

more pronounced, without, however, sacrificing the simplicity characteristic of all these chandeliers. This design is made with either two or four arms and equipped with 66, 88, 110 or 132 watt lamps, either 110 or 220 volts, as desired. The four arm 132 watt chandelier has an illuminating value equivalent to 28 16-candlepower carbon filament lamps

HARVARD ELECTRIC COMPANY'S GROWTH.

The Harvard Electric Company, 66 West Van Buren street, Chicago, and 136 Liberty street, New York, manufacturers of electrical necessities, have begun the year of 1909 with numerons evidences of growth. Its president, Fredric Greer, is one of those who predict great things for the coming era of prosperity.

This company has recently greatly increased its space and more than doubled the capacity of its plant.

This company manufactures Harvard patent channel steel brackets, beveled edge wire joints, sectional switch boxes, conduit boxes, telephone fuses, lightning arresters, fuse wire, fuse strip, open fuse links, magnet winders, cable hangers, portable lamp guards, test connectors, etc., etc.

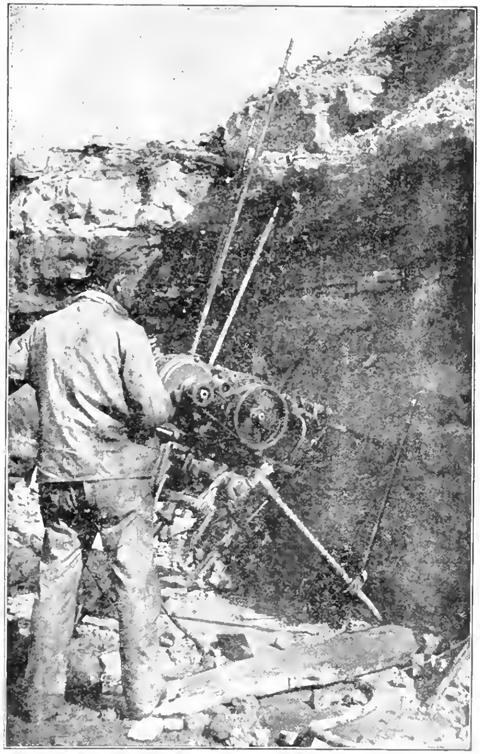
The advance 1909 No. 17 bulletin illustrating a part of the products of this company has just been issued and distributed to the trade. Copy of this bulletin will be forwarded to any one interested, upon request.

THE NORTHERN ELECTRIC ROCK DRILL.

Considerable interest is being manifested in the mining field by the introduction of a new type of electrically driven rock drill by the Northern Electrical Manufacturing Company, of Madison, Wis., recently consolidated with the Fort Wayne Electric Works, which is a radical departure from anything heretofore offered in place of its predecessor, the air drill.

The accompanying illustration is a photograph taken of this drill while in operation, and is notable for the absence of vibration while running.

It has been demonstrated a number of times that it is practically impossible to transmit the energy from an electric motor to a piston type of drill, due to the excessive vibration and jar on the apparatus as a whole. This drill is rotary in



Northern Electric Rock Drill in Quarry.

its action and embodies one or two hammers (as the case may require), mounted in a rotating body where full advantage is taken of the storage of energy possible in a flywheel. This is in very marked contrast to any form of drill where the blow is imparted to the rock through the medium of a reciprocating piston. The accompanying figure shows the hammer mechanism in place and is self-explanatory of the general design of the apparatus.

As the helve revolves the hammer is thrown outward into striking position by centrifugal force. Reaching the projecting head of the drill chuck, it delivers to it in the form of a blow the energy stored up in the revolving helve. The hammer,

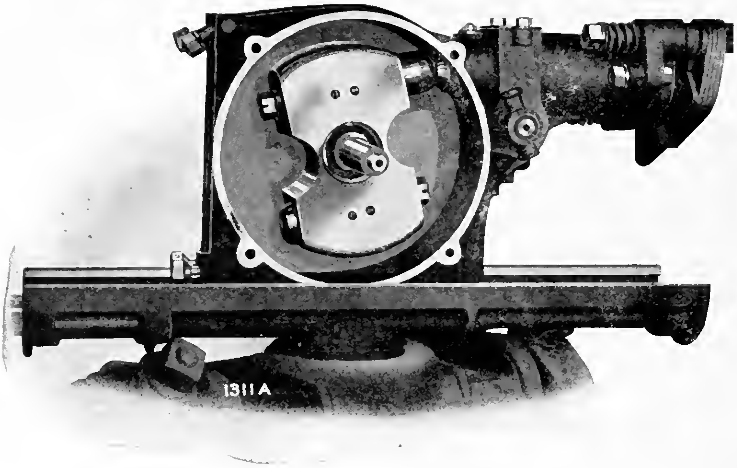
after delivering the blow, rebounds into the chamber in the helve, where it is cushioned so completely by the air which it traps that no vibration is imparted to the drill itself.

It is noticeable in the illustration that no weights at all are used to absorb vibration, as is common in air and piston type of drills.

The chuck and drill steel are held into the drill body by means of a laminated steel combination buffer head and clamp, which both locks the steel in place and absorbs the shock when the drill is not cutting. The object of this buffer head is to permit operating the drill a full speed when the drill is not seated on the rock.

By the use of the hollow drill steel it is possible to drill deep holes in any direction in the softest rock or ores of high specific gravity, which under actual drilling break into small fragments instead of pulverizing. In working in various hard rocks and shallow holes it is not necessary to use water with the drill, although in many instances it is highly advisable to use the water system to kill the dust, which it is impossible to do with a steam or air drill using solid drill.

The drill steel is not reciprocating, and therefore cannot be jammed into a fissure or cleavage crack. To rotate the drill steel a simple mechanism has been devised which gives



Mechanism of Northern Electric Rock Drill.

the drill a positive turning action. Much interest is centering around this new type of drill and its future will be watched with high expectations by those who believe that all things are possible through the medium of electrical applications.

SODIUM FOR DRYING TRANSFORMER OILS.

Recent experience in connection with the drying of transformer oils indicates that by the use of metallic sodium moisture may be completely removed from oils which are to be used for insulating purposes. This means, of course, that the insulating qualities of the oil will be raised in a very marked degree.

The method of using sodium for drying hydro-carbon oils is one that is familiar to every chemist who has ever measured the di-electric constants of these oils where the sodium is usually added in the final operation to remove the very last traces of moisture. In the fear that the caustic formed by the reaction of the moisture on the sodium might be left as a liquid or a solid in the hydro carbon, the chemist has usually thought it necessary to distill off from the sodium. In working on a very large scale this fear has been found to be groundless, and it is absolutely unnecessary to distill the oil.

The oil on the granulated sodium is poured off and a good transformer oil poured over the metal. To the oil which is to be treated, and which is put into an open tank or barrel, the sodium is added at first very carefully, about one ounce to the barrel. If much hydrogen is evolved this will be conclusive proof that there is much water in the oil, and the balance of the sodium should be added carefully and in small amounts. The amount which is to be added depends upon the oil, but as a rule one pound to the barrel is usually much more than is required. The oil is then stirred up three or four times a day for a minute at a time. After several days the oil may be removed and tested, but the longer it remains over the sodium the better the oil becomes.

Another method used is to put the sodium in the form of sticks in a cylinder of iron wire of about 28 mesh and hang the cylinder in the oil.

One company has taken oils which broke down at 3,000 volts and by letting them stand over the sodium for two days have brought their breaking points up to 20,000 volts or higher.

The Roessler & Hasslacher Chemical Company of New York are selling agents for sodium.

U. S. GEOLOGICAL SURVEY TESTING PLANT.

The long series of producer gas tests on various grades of bituminous coal conducted by the United States Geological Survey at the St. Louis Exposition have been productive of such fruitful results that the testing work has been perpetuated, and the Government has secured for this purpose a 140-horsepower Westinghouse 3-cylinder vertical single-acting gas engine. This engine is of the same type as that installed at St. Louis, upon which all of the producer gas tests were made. An important schedule of experimental work has been laid out by the Government engineers, and tests will be run on all classes of bituminous coals, lignites, peat, etc.

TRADE NOTE.

R. P. Chevalier, 930 Lincoln avenue, Alameda, Cal., has recently installed complete laboratory equipment for fuel analysis, both oil and coal, and is equipped to handle every detail of testing boilers and engines. This apparatus includes every device from scales to fuel calorimeter, making it one of the most complete equipments for such tests on the Coast

NEWS NOTES

FINANCIAL.

OAKLAND, CAL.—The Southern Pacific Company has made public the terms of its contracts for equipment for an electrical power station at Fruitvale, on the tidal canal, and for motor cars for the electric propulsion of local trains when steam power is discarded. The contracts called for an expenditure of $748,960 and were placed with Eastern firms late in the year 1907. The General Electric Company of Schenectady, N. Y., secured the contract for the rolling stock, calling for 44 multiple unit, four motor cars, the contract price being $374,960. The stationary equipment in the power house, consisting of two 5,000 kilowatt turbo generators capable of supplying current for a widely distributed trackage, will be supplied by the Westinghouse Company, of East Pittsburg, at a contract price of $190,000. Steam for the operation of the turbo-generators will be supplied from a battery of twelve 645 horsepower water-tube boilers. The boilers will be installed by the Parker Boiler Company, of Philadelphia, at a cost of $137,000. The condensing outfit will be supplied by the Henry R. Worthington Company of New York at a cost of $47,000. Work on the power house has been begun and is being actively rushed to completion, after which work will begin on the overhead system for the electric trains.

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Specializing Hardware & Electrical Company has been formed here with a capital stock of $25,000 by S. L. Bigelow, J. H. Kahn and H. C. Thaxter.

LOS ANGELES, CAL.—The C. C. Harris Oil Company has been formed here with a capital stock of $300,000 by John D. Bicknell, J. C. F. Hull, H. G. Gates, E. E. Gates and C. C. Harris.

VISALIA, CAL.—The Monache Water Company has been incorporated here with a capital stock of $14,000, the principal place of business being Porterville. The incorporators are J. H. Williams, of San Diego, W. E. Sprout and A. J. Newbury, of Porterville.

TRANSMISSION.

TONOPAH, NEV.—The Nevada-California Power Company has begun work on the construction of the new power line to Manhattan and Round Mountain.

CANANEA, MEXICO—The Pinos Altos Mines Company is at work installing one of the most complete electrical equipments used in any of the mines of this country.

CHICO, CAL.—An application has been made by Frank C. Wilson, representing the Sierra Electric Power Company, for a franchise for the transmission of power in this city.

PASADENA, CAL.—An ordinance has been passed here calling for the issuance of bonds to the amount of $150,000 for electric generators and other municipal improvements.

PRESCOTT, ARIZ.—Hon. I. T. Stoddard has about completed plans for installing electrical machinery in the mines near Stoddard, arranging for power from the Arizona Power Company's plant on Fossil Creek.

PHOENIX, ARIZ.—President Charles S. Smith, of the Old Dominion Copper Company at Globe, Ariz., has about completed plans for the installation of a 2,000-kilowatt plant in the smelter power house at Globe.

SAN JACINTO, CAL.—Mr. Whittier, owner of the Hemet dam, in the San Jacinto Mountains, announces that the expenditure of a million dollars is contemplated in the near future on the erection of an electrical power plant which is to be installed below the dam, which is now being raised 25 feet higher.

MESA, ARIZ.—Superintendent Hector Gillis, at Granite Reef, is rushing the work of connecting the Consolidated canal with the headgates of the big dam at Arizona heading, where a power house is soon to be erected.

ILLUMINATION.

YACOLT, WASH.—J. Coulter has been given a contract to construct a light and power plant for Yacolt.

SAN DIEGO, CAL.—A contract has been let to Shaffer & Moses to lay underground light mains and install fixtures for the ornamental light system on D street.

SIERRA MADRE, CAL.—Bonds have been issued in this city for $30,000 for erecting a gas plant with a capacity to serve 6,000 families. Work is to begin within three months.

SAN FRANCISCO, CAL.—Sealed bids will be received by the Board of Public Works till March 8th, 1909, for electrical wiring and apparatus for the O'Farrell street truck house No. 1.

COLUSA, CAL.—The Pacific Gas & Electric Company is soon to begin a number of improvements here, the most important of which is the installation of a 20,000 cubic foot gas holder tank.

LOS ANGELES, CAL.—Specifications for new machinery needed by the municipal electric light plant, amounting to between $35,000 and $40,000, have been presented to the City Council.

HUNTINGTON BEACH, CAL.—Lee Ledanyi has purchased the controlling interest in the local gas plant from F. M. Burbank and it is expected that extensions and improvements will soon be made.

SAN BERNARDINO, CAL.—It is understood that C. S. Chestnut, of Redlands, the recent purchaser of the Colton gas plant, will build a large central gas plant in Colton for supplying that and other towns with gas.

AZTEC, N. M.—The Eden Canal, Land & Power Company has begun work on the construction of its new electric light plant which is to be located on two acres of land acquired a few weeks ago from L. Current.

PASADENA, CAL.—Bids will be received till March 23, 1909, for furnishing this city with materials and equipment for a municipal light plant. The desired articles are one surface condenser and equipment, one 750-800-kilowatt, 3-phase, 60-cycle, 2,300-volt engine-type alternating current generator, together with a 50-kilowatt 125-volt belted exciter, and one additional exciter, 1 vertical cross-compound condensing engine, one 750-800-kilowatt turbo-generator unit.

TRANSPORTATION.

LEWISTON, IDAHO.—Nearly $80,000 has already been raised for the construction of the electric railway at Lewiston.

SAN DIEGO, CAL.—A franchise for a period of twenty-five years has been granted the Point Loma Railroad Company.

LOOMIS, WASH.—Work is to be commenced at once on an electric railway from Loomis to Nighthawk. I. Inman is in charge.

EUGENE, OREGON.—The Portland, Eugene & Eastern Railway expects to complete the electric road between Eugene and Springfield this year.

SPOKANE, WASH.—The Washington Water Power Co. is starting the construction of a new hydro-electric power house to furnish power to the Medical Lake and Cheney lines.

FRESNO, CAL.—F. S. Granger announces that rights of way have been secured for the Fresno-Hanford Railway from Hanford to the Calwa winery and that everything is in readiness for work to begin.

SANTA, ANA, CAL.—The Pacific Electric Company has not decided whether it will build its line direct from Los Angeles or run it from Talbert to Garden Grove and there connect with the line already in operation.

VALLEJO, CAL.—Attorney York, of Napa, acting for the Vallejo, Benecia & Napa Valley Electric Railway, has asked the trustees for a new route from this city in order that the company may escape the grade on Sonoma street.

PORTLAND, ORE.—Permission has been granted the Portland Railway, Light & Power Company to lay its tracks for an extension through Fairview to connect with the O. R. & N., pending the passage of a 30-year franchise by the City Council.

NORTHBEND, ORE.—Seymore H. Bell, representing the Coos Bay Electric Railway Company, announces that work on the construction of the electric road between Marshfield and this point will begin as soon as the thirty-year franchise is granted.

SACRAMENTO, CAL.—The Central Traction Company has applied for an electric railway franchise in this city. When this is granted construction work will begin immediately. The building of this road will complete the company's line from Stockton to this city, and a saving of twenty-five minutes will be made to Eighth and L streets. It is understood that an agreement has been reached under which the Central Traction, the Vallejo Northern, and the Northern Electric companies will build a union depot for passenger traffic near Eighth and I streets. Within a few months the Northern Electric Company will have completed rail connection with the river, thus affording development of its freight business.

OIL.

GOLDFIELD, NEV.—Oil in considerable quantities has been struck in this vicinity at a depth of 825 feet.

LOS ANGELES, CAL.—A protest has been raised by the Mayor and citizens of Santa Barbara against the Union Oil Company running its pipe lines into the Pacific Ocean to serve ships and trade generally. The complaint is that the city's reputation as a beach resort will be ruined.

FRESNO, CAL.—A deal has been closed during the past week whereby the ownership of 120 acres of proven land in the heart of the oil district has been acquired by a number of Southern California capitalists for a price that is not known. It is reported that a corporation is to be formed and active development will be commenced.

BAKERSFIELD, CAL.—At the annual meeting of the Associated Oil Company, held last week, the following officers were chosen: President, J. A. Chanslor, San Francisco; W. S. Porter, first vice president and general manager, San Francisco; W. F. Chandler, second vice president, Selma; secretary, O. Scribner, San Francisco, and treasurer, W. A. Sloane, San Francisco.

BAKERSFIELD, CAL.—A suit by James H. Martin against the Sunset Rex Oil Company, Mark B. Smith, Mary H. Smith, Harold Smith, John Doe and Richard Roe, is now in the Supreme Court to decide whether "non-assessable" oil stock is assessable. The plaintiff claims that he bought $700 worth of stock in the company, with the understanding that it could not be assessed, but that thereafter the board of directors levied an assessment of 10 cents per share on the company's stock and that his stock is now about to be sold.

LOS ANGELES, CAL.—Because of the disordered traffic resulting from the floods and the increase of shipments due to the heavy demand, a car famine has resulted in the Kern county oil fields, reports A. G. Nichols, field manager for a number of companies. Water has also become quite scarce in a number of localities, several companies securing water from the wells about Santa Maria Springs. The Temblor Company has opened up a new field north of McKittrick and the Oneonto Company has begun big developments.

WATER.

COALINGA, CAL.—Rubenstein, Cospers & Kauntze, of Hanford, have been granted a franchise to lay a water system in this city.

SANTA CLARA, CAL.—The bids of the United States Pipe Company for forty-four and one-half tons of pipe at $34.70 and for one ton of fittings at $65 have been accepted.

PETALUMA, CAL.—Sealed bids will be received till May 3d, 1909, by the city clerk for furnishing and installing the pumping machinery for a salt water high pressure fire system in this city.

GLENDORA, CAL.—The Glendora Mutual Water Company has sold $35,000 in bonds to Adams & Co., of Los Angeles, at very near par value, to bear interest at 6 per cent., on long terms of payment.

EUREKA, CAL.—The Eureka Water Company, following the recent steps taken toward securing municipal ownership, has announced that $100,000 will be spent during the coming year in making improvements to its system.

SAN FRANCISCO, CAL.—Formal approval has now been given to the specifications for the 45,000 tons of cast iron pipe required for the proposed auxiliary fire protection system. Bids have been called for to be opened March 10th.

SAN FRANCISCO, CAL.—Sealed bids will be received at the office of the Board of Public Works of this city till March 10th, 1909, for furnishing and delivering cast iron pipe, according to the specifications prepared by the city engineer.

GRIDLEY, CAL.—The Nevada Machinery & Supply Company, of San Francisco, has been awarded the contract to furnish a pumping plant for the city water works, the price being $7,820. The plant will include a steam boiler and steam pumps and also electric motor and centrifugal pump.

TELEPHONE AND TELEGRAPH.

SAN FRANCISCO, CAL.—The Atchison, Topeka & Santa Fe will begin installing the necessary equipment for dispatching by telephone on 1,124 miles of its road as soon as the material can be supplied. The territory to be equipped includes the line from Chicago to Emporia, Kans., via. Ottawa, Kans.; from Bakersfield to Oakland on the valley division of the coast lines, and from Somerville, Tex., to Beaumont, on the gulf lines. The company has already 226 miles of its road operated by telephone dispatching and the entire line from Kansas City to Newton will be ready for service soon. This, with the proposed addition of 1,124 miles, will make a total of 1,350 miles of road that will have telephone train wires.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer — who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

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erkins Elec. Switch Mfg. Co.

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alworth & Neville Mfg. Co.
estern Electric Co., "Walworth & Neville."

MAST ARMS

ec. Appliance Co., "Cutter"
. Wayne Electric Works.
eruiff, B. F., Jr. & Co., "Cutter."
estern Elec. Co., "Fletcher"

TELEPHONE TRANSMITTER ARMS

an Electric Co.
ec. Appliance Co., "Eaco."
eruiff, B. F., Jr. & Co., "Sterling."
erling Elec. Co.
estern Elec. Co.

INDEX TO ADVERTISEMENTS

ASBESTOS

Johns-Manville Co., H. W.

BATTERIES

DRY BATTERIES

Dean Electric Co.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

DRY BATTERY HOLDERS

Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES

Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY

Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

STORAGE BATTERIES

Elec. Storage Battery Co.
Westghse Machine Co.

BELLS

ELECTRIC BELLS

Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

ELECTRO-MECHANICAL GONGS

Edwards & Co.
Electric Goods Mfg. Co.
Marshall Elec. Co.
Partrick, Carter & Wilkins Co

MAGNETO BELLS

Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co
Standard Elec. Wks., "C & S"
Western Electric Co.

BOILERS

Henshaw-Bulkley & Co.
Keystone Boiler Wks., "Parker."
Moore & Co., Chas. C., "B. & W."
Standard Electrical Works, "Robb-Mumford."
Tracy Engineering Company, Edge Moor."

BOOKS

Technical Book Shop.

BOXES

WALL BOXES

Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knock-out."
Chicago Fuse Wire & Mfg Co., "Union"
Cole Co., John R., "Bossert"
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
General Electric Co.
Harvard Elec. Co.
Holabird-Reynolds Elec. Co.
Marshall Electric Co.
Sprague Electric Co., "Universal."
Standard Elect'l Wks., "M & M."
Stanley & Patterson, Inc., "Simplex."

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity Power and Gas *604 Mission Street, San Francisco.*

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.

Journal of Electricity, Power and Gas,
604 Mission Street, San Francisco.

AGENTS WANTED on a guaranteed weekly salary to represent our two publications, "Southern Engineer" and "Southern Machinery"; liberal terms for exclusive services, easy sellers; every engineer and every machinist is interested. Write at once. For further information, address W. R. SMITH PUB. CO., Sub. Dept. Atlanta, Georgia.

WANTED—Men coming in direct touch with Steam, Electrical Superintending Engineers and Shop Foremen. A proposition that can be handled by energetic persons to good advantage. Liberal commission and permanent work. CHAS. L. TURNER, 907 Atlas Bldg., San Francisco, Cal.

POSITION WANTED by an experienced electrician with some business ability. First-class references on this Coast. Will accept low salary if oportunity for advancement Address Box 102, **Journal of Electricity.**

FOR SALE at bargain prices: Two 6-wide, 9-high, 18 ft. Babcock & Wilcox wrought iron front boilers in first-class condition. For particulars, see B. W. RICE, 1119 Metropolis Bank Building, San Francisco.

FOR SALE at a bargain—3-25 K. W. 1040/2080 to 230/460 volts, Gen. Elec. Oil Transformers; have been used but a year; are in perfect operative condition; change made to higher voltage. Address Hood River Elec. Lt., Pr. & Water Co., Hood River, Ore.

SITUATION WANTED—By electrical engineer with 15 years' experience in designing and estimating of electric power plants, switch gears, light, motor and storage battery installations; also in central station service. Advertiser takes also draughting work in this line as home occupation if no steady engagement can be attained. Moderate expectations. Address Box 101, **Journal of Electricity,** San Francisco.

$100.00 REWARD to the party who will successfully procure an electrical engineer of wide experience in erecting and operating electric power plants, storage batteries, etc., position with reputable contracting firm or power plant. Inquire Box 103, **Journal of Electricity, Power and Gas.**

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CEILING BRACKET AND DESK FIXTURES

Stanley & Patterson, Inc., "Sunlight."

DESK TELEPHONE BRACKETS

Stanley & Patterson, Inc., "Imperial."
Sterling Elec. Co. "Equipoise."
Western Electric Co

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Western Elec. Co, "Fletcher"

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ARC LIGHT CARBONS

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Westghse Elec. & Mfg. Co.

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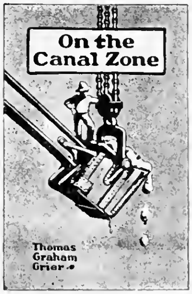

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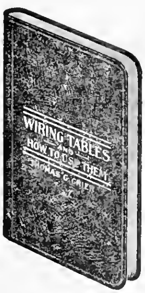

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General Electric Co.
Kieruiff, B. F. Jr. & Co., "Excelsior."
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JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXII. SAN FRANCISCO, MARCH 13, 1909 NUMBER 11

A MICHIGAN TELEPHONE SWITCHBOARD.

The accompanying illustration shows a model switchboard and telephone equipment of a recent exchange installation at Coldwater, Mich. It will be noted that the exchange equipment consists of three sections of six-panel, three-position, multiple-type switchboard, each section having an ultimate capacity of 3000 multiple jacks and 540 answering jacks and lamps. Five hundred and sixty common battery, 50 rural and 40 toll lines were installed in connection with the new exchange equipment. The cord circuits in each local operator's position are of the double lamp supervision with individual four-party line ringing and listening keys. The operator's telephone sets are equipped with suspended type transmitters. Ten incoming rings through toll trunk circuits were installed between the local switchboard and the toll board.

At first one section of the two-position non-multiple toll board was installed having a present equipment of 40 toll lines. These toll lines were provided with switching keys so wired that the same may be switched to the local switchboard for night toll service. Ten recording toll trunks were multipled in each section of the local switchboard and cabled to the toll board. The cord circuits at each position of the toll board were of the universal type with double lamp supervision and single party line ringing and listening keys.

Switchboard and Telephone Equipment at Coldwater, Michigan.

In the foreground will be seen a one-position chief operator's desk which was equipped with the necessary listening-in taps, lines to local switchboard, toll board and wire chief's desk for supervising the service.

There was also a one-position wire chief's desk installed.

equipped with lines and testing trunks to local switchboard, also lines to chief operator's desk and toll board, and a testing trunk to main frame. A testing cord circuit is provided with standard voltmeter for making all of the necessary tests in an exchange of this type.

In this exchange there is a main distributing frame having a present framework of 700 subscribers' lines. This frame is equipped with arresters of the Kellogg type for 560 subscriber's 50 rural and 40 toll lines.

There is also an intermediate distributing frame having a present framework for 700 subscriber's lines. It may be stated that the power equipment installed in this exchange consists of one set of eleven cells of electric storage batteries, one motor generator charging set, one slate power switchboard, two-four-frequency vibrating harmonic pole changers, one gasoline engine and one belted changing generator. It was installed by the Kellogg Switchboard and Supply Company of Chicago.

PRELIMINARY CENSUS REPORT ON TELEPHONES.

Number of Stations or Telephones, by States, December 31, 1907.

	Total	Independ't (non Bell)	Bell (American) T. & T. Co.	Independ't Stations connected with BellSystem
United States	6,118,578	2,986,515	3,132,063	([1])835,880
Alabama	40,481	14,985	25,496	3,944
Arizona	6,203	3,148	3,055	.....
Arkansas	49,576	32,150	17,426	10,265
California	237,672	65,977	171,695	9,607
Colorado	65,908	4,473	61,435	1,620
Connecticut	63,898	1,815	62,083	352
Florida	17,522	11,160	6,362	3,691
Georgia	62,260	26,204	36,056	9,072
Idaho	16,394	5,754	10,640	1,288
Illinois	558,585	285,322	273,263	109,101
Indiana	289,452	216,990	72,462	50,065
Iowa	332,545	279,773	52,772	74,806
Kansas	200,233	161,913	38,320	66,880
Kentucky	93,996	51,796	42,200	9,038
Louisiana	35,692	6,184	29,508	4,351
Maine	53,134	16,024	37,110	7,830
Maryland, D. C. and Del.	110,282	19,896	90,386	217
Massachusetts	209,383	5,324	204,059	650
Michigan	209,842	106,049	103,793	30,933
Minnesota	171,479	114,618	56,861	46,547
Mississippi	37,627	13,567	24,060	5,235
Missouri	312,527	220,823	91,704	82,393
Montana	17,168	8,118	9,050	846
Nebraska	153,279	105,610	47,669	45,252
Nevada	4,601	2,081	2,520	734
New Hampshire	28,920	6,488	22,432	2,482
New Jersey	116,988	19,134	97,854	831
New Mexico	6,653	3,476	3,177	759
New York	685,512	180,759	504,753	23,992
North Carolina	37,104	20,597	16,507	4,714
North Dakota	34,087	26,635	7,452	10,542
Ohio	495,636	312,278	183,358	29,284
Oklahoma	68,125	38,009	30,116	35,570
Oregon	49,629	16,223	33,406	10,675
Pennsylvania	450,403	174,582	275,821	11,976
South Carolina	20,911	7,872	13,039	1,867
South Dakota	48,405	44,751	3,654	25,939
Tennessee	71,130	25,758	45,372	9,241
Texas	187,862	108,832	79,030	30,334
Utah	30,630	10,528	20,102	451
Vermont	30,833	13,917	16,916	7,020
Virginia	55,541	24,118	31,423	4,447
Washington	98,846	35,652	63,194	9,168
West Virginia	62,144	46,609	15,535	3,238
Wisconsin	158,875	89,005	69,870	36,366
Wyoming and R. I.	30,605	1,538	29,067	1,267

[1]Fignres furnished by American Tel. and Tel. Co. included the total for Independent.

German telephone rates will be increased by a measure now before the Reichstag. The bill proposes to abolish the present system whereby Berlin subscribers got an unlimited service for $43.20 a year, substituting an annual rental charge of $21 for telephones, with an additional fee of 1 cent for every connection made. The bill affects all Germany, but its provisions would be felt especially in Berlin, where it is computed that the result would be the raising of the average annual cost of business telephones to $72 or $96, or even in the case of some firms to $144.

REPORT UPON PACIFIC TELEPHONE AND TELEGRAPH COMPANY, SAN FRANCISCO.

By C. L. Cory.

To the Honorables, the Mayor and the Board of Supervisors, of the City and County of San Francisco, San Francisco, California:

Gentlemen: In compliance with your resolution No. 2517 (New Series) dated July 14th, 1908, I have made a personal inspection and examination of the complete equipment of The Pacific Telephone and Telegraph Company in San Francisco, including its books, records, engineering data, etc., and beg herewith to submit the following

REPORT:

The information required by your resolution is included under three headings, as follows:

1. The true valuation of the plant of the Company in San Francisco on July 1st, 1908, and also all additional investments which rightfully increase this valuation from July 1st, 1908, to January 1st, 1909.

II. The number of telephones operated by the Company in San Francisco on January 1st, 1908, the additional telephones installed during each month of the year, and also the average revenue to the Company per telephone.

III. The annual cost of operation including a proper segregation of accounts.

I.

Valuation of Plant.

In determining the valuation of the plant of the Company there has been included the entire installation in San Francisco which is necessarily a part of the San Francisco exchange. All equipment and materials of every character not directly a part of this exchange and used in its operation have been excluded. In other words, no part of the general plant of The Pacific Telephone and Telegraph Company not directly a part of the San Francisco system, and actually required and used in its San Francisco business has been included.

Immediately after July 1st, 1908, the Company began to make complete and detailed inventories of the component parts of the entire San Francisco system, the methods and classifications having been previously agreed upon between the Company and myself.

These inventories were largely made jointly by a representative of the Company and a representative of myself and were compiled in forms readily and easily checked and verified by me. The actual installation as represented by the inventories has been examined in sufficient detail by me to establish the fact that there is included only such portions of the installation as are required and used in the operation of the San Francisco exchange.

The valuation of the plant has, in every instance possible, been made on the basis of the actual cost to the company, but in all cases where the actual cost for any reason could not be determined, careful estimates were made of the probable cost.

The valuation of the various portions of the entire installation as determined is as follows:

THE PACIFIC TELEPHONE AND TELEGRAPH COMPANY.

Exchange Plant, San Francisco, Cal.

July 1, 1908.

SUMMARY.

FIXED PLANT—

Exchange Pole Line.		
Poles	$ 179,152.49	
Cross Arms	39,434.38	
Guys	26,634.03	
Stubs	490.27	
Total		$ 245.711.17

Exchange Right-of-way		36,000.00
Exchange Aerial Cable.		
Aerial Cable	192,270.12	
Fence and House Cable	25,205.92	
Aerial Cable Terminals	40,434.54	
" " " Platforms.	373.58	
" " Bonds	1,218.96	
" " Moulding	67.45	
Fence " " "	3,783.85	
Open Fuses	2,532.95	
Total		265,887.37
Exchange Aerial Wire.		
Line Wire	60,978.45	
Drop Wire	152,071.88	
Ring and Wall Wiring	31,652.13	
Bridle Wiring	2,598.63	
Total		247,301.09
Exchange Underground Conduit.		
Main Conduit	820,641.43	
Lateral Conduit	202,092.56	
Stand Pipes	2,296.84	
Manholes	130,053.87	
Handholes	37,558.99	
Total		1,192,643.69
Exchange Underground Cable.		
Main Cable	1,175,350.46	
Lateral Cables	83,920.78	
U. G. Cable Terminals	66,830.69	
Terminal Platforms	1,314.37	
U. G. Cable Bonds	3,689.43	
U. G. Cable Moulding	2,268.81	
U. G. Cable Boxing	964.74	
Total		1,334,339.28
Exchange Equipment Central Office.		
Kearny	406,321.24	
Market	245,295.54	
West	251,713.79	
Franklin	154,045.90	
Chinatown	4,024.78	
Buchertown	955.60	
Total		1,062,356.90
Exchange Equipment Substation.		
Subscribers' Sets	318,736.35	
Wiring and Miscellaneous Material	66,183.09	
Labor Installing	101,324.15	
Substation Protection	13,188.32	
Special Substation Arrangem'ts.	6,148.41	
Private Branch Exchange	238,357.86	
Public Pay Stations	13,760.93	
Total		757,699.11
Total for Fixed Plant		$5,141,937.61

MISCELLANEOUS PLANT—

Tools and Teams		$ 44,545.43
Furniture and Fixtures		15,815.34
General Supplies		65,350.71
Real Estate.		
Lots—		
Kearny Office Lot (90%)	$ 41,976.00	
Market Office Lot	24,698.00	
West Office Lot	19,875.00	
Franklin Office Lot	31,800.00	
Pacific Office Lot	3,625.81	
Mission Office Lot	5,982.28	
Park Office Lot	7,420.00	
Executive Office Lot (66 2-3%)	113,066.67	
Mission Public Office lot	9,752.00	
Total for Lots		$ 258,195.76
Buildings—		
Kearny Office Building (90%)	$ 190,532.42	
Market Office Building	131,612.25	
West Office Building	128,921.50	
Franklin Office Building (Part)	11,118.26	
Park Office Building	8,189.20	
Executive Office Building (40% only)	21,563.35	
Mission St. Public Office Bldg.	719.54	
Barn and Stable	10,528.98	
Garage	1,052.90	
Carpenter and Paint Shop	1,754.83	
Stable Hospital	175.48	
Blacksmith Shop	175.48	
Plant Department Store Room	175.48	
Van Ness & Eddy Public Office	701.93	
Butchertown Office	935.91	
Sausalito Ferry Public Office	467.95	
Total for Buildings		620,143.23
Total for Lots and Buildings		878,638.99
Total Plant Valuation, July 1, 1908		$6,146,288.08

The additional investment of the Company in San Francisco from July 1st, 1908, to January 1st, 1909, was obtained from the books of the Company, and includes the amount actually spent during that period which is properly chargeable to the capital account.

The additional investment as segregated into the different portions of the plant from July 1st, 1908, to January 1st, 1909, is as follows:

ADDITIONS TO PLANT.

July 1st, 1908, to January 1st, 1909.

Exchange Pole Line	$ 39,750.36
" Right of Way	1,877.30
" Aerial Cable	82,483.63
" Aerial Wire	38,662.66
" U. G. Conduit	51,602.35
" U. G. Cable	98,420.85
" Equipment—Central Office	49,423.68
" " —Substations	126,286.46
Tools and Teams	4,105.36
Furniture and Fixtures	6,808.62
General Supplies	56,630.35
Real Estate	50,840.13
Construction in Process on January 1st, 1909	15,089.99
Total	$621,981.74

The total investment represented in the various portions of the plant on January 1st, 1909, also on July 1st, 1908, and the increase in investment during the period from July 1st 1908, to January 1st, 1909, are given below:

THE PACIFIC TELEPHONE AND TELEGRAPH COMPANY.

Exchange Plant, San Francisco, Cal.

July 1st, 1908, and January 1st, 1909.

	Valuation July 1, 1909.	Additions to Plant July 1, '08, to Jan. 1, '09.	Valuation Jan. 1, 1909.
Exchange Pole Line	$245,711.17	$39,750.36	$285,461.53
" Right of Way	36,000.00	1,877.30	37,877.30
" Aerial Cable	265,887.37	82,483.63	348,371.00
" Aerial Cable	247,301.09	38,662.66	285,963.75
" Underground Conduit	1,192,643.69	51,602.35	1,244,246.04
" Underground Cable	1,334,339.28	98,420.85	1,432,760.13
" Equipment—Central Office	1,062,356.90	49,423.68	1,111,780.58
" Equipment—Substations	757,699.11	126,286.46	883,985.57
Tools and Teams	44,545.43	4,105.36	48,650.79
Furniture and Fixtures	15,815.34	6,808.62	22,623.96
General Supplies	65,350.71	56,630.35	121,981.06
Real Estate	878,638.99	50,840.13	929,479.12
Construction in Process, Jan. 1, 1909		15,089.99	15,089.99
Totals	$6,146,289.08	$621,981.74	$6,768,270.82

Valuation of Plant, July 1, 1908	$6,146,289.08
Additions to Plant, July 1, 1908, to Jan. 1, 1909	$ 621,981.74
Valuation of Plant, Jan. 1, 1909	$6,768,270.82

II.

Number of Telephone Stations and Average Revenue.

The number of telephones installed and in operation January 1st, 1908, the number connected, disconnected and net gain for each month during the year 1908, also the telephones in operation on the first of each month of 1908 and on January 1st, 1909, are given below:

	Connected.	Disconnected.	Net Gain.	1st of Month.
January	1,659	970	689	*35,367
February	1,981	988	993	36,056
March	2,014	1,275	739	37,049
April	2,366	1,144	1,222	37,788
May	2,195	1,266	929	39,010
June	1,906	1,389	517	39,939
July	1,903	1,190	713	40,456
August	2,148	1,078	1,070	41,169
September	3,138	1,006	2,132	42,239
October	2,647	1,056	1,591	44,371
November	1,787	578	1,209	45,962
December	1,939	577	1,362	47,171
	25,683	12,517	13,166	

Total Stations January 1, 1909 .... **48,533

Including 211 Private Branch Switchboard Stations
**Including 508 Private Branch Switchboard Stations.

From these figures it will be seen that the net gain in telephones in operation for the year 1908 was 13,166, which is a gain of 37.2 per cent over the number in operation on January 1st, 1908.

The average revenue per telephone for each month during the year and also the average revenue per telephone for the first six months and for the last six months is shown in the following statement:

MONTHLY STATEMENT OF STATIONS IN SAN FRANCISCO FOR 1908.

Month	Number on 1st.	Net Gain during Month	Average for Month.	Revenue from Stations.	Ave.Rev per Station
January	35,367	689	35,711	$156,980.53	$4.396
February	36,056	993	36,552	153,571.86	4.201
March	37,049	739	37,418	160,056.65	4.277
April	37,788	1,222	38,399	162,689.36	4.211

May	39,010	929	39,171	166,149.17	4.209
June	39,939	517	40,197	164,967.17	4.103
July	40,456	713	40,812	150,753.71	3.694
August	41,169	1,070	41,704	153,588.33	3.683
September	42,239	2,132	43,305	162,096.13	3.713
October	44,371	1,591	45,166	166,138.63	3.678
November	45,962	1,209	45,566	172,139.67	3.696
December	47,171	1,362	47,859	181,994.19	3.803

Average Revenue per station, Jan. 1st to June 30th......$4.233
Average Revenue per station, July 1st to Dec. 31st......$3.711

The average revenue per station as given is obtained from the total revenue from stations and the total number of stations, including extensions, private branch exchange stations, dead-head telephones, etc.

The reduction of the average revenue from $4.233 for the first six months to $3.711 for the last six months is due in part to the reduction in rates on July 1st, 1908, and in part to the increase in the number of telephones in operation.

The average revenue per telephone for the different classes of service during December, 1907, and during December, 1908, is given below and shows the effect of the reduced rates, beginning July 1st, 1908.

	December, 1907	December, 1908
Business Measured—		
No. of Stations	1,989	2,702
Total Revenue	$26,210.02	$32,936.26
Ave. Revenue per Station	$13.19	$12.19
Business Prepayment—(Nickel in Slot).		
No. of Stations	7,716	9,690
Total Revenue	$48,847.50	$58,9[illegible].05
Ave. Revenue per Station	$6.[illegible]	$6.08
Residence Unlimited—		
No. of Stations	5,82[illegible]	[illegible]
Total Revenue	$2[illegible],107.50	$[illegible].15
Ave. Revenue per Station	$3.80	$[illegible]
Residence Measured—		
No. of Stations	(None)	442
Total Revenue		$1,[illegible].15
Ave. Revenue per Station		$2.[illegible]
Residence Prepayment—		
No. of Stations	7,127	9,219
Total Revenue	$[illegible].10	$16,302.25
Ave. Revenue per Station	$1.63	$1.77
Private Branch Exchanges—		
No. of Stations	7,778	11,[illegible]
Total Revenue	$[illegible]	$[illegible]
Ave. Revenue per Station	$[illegible]	$3.64
Extensions—		
No. of Stations	[illegible]	5,601
Total Revenue	$[illegible]	$[illegible]
Ave. Revenue per Station	$[illegible]	$[illegible]
Miscellaneous—		
No. of Stations	[illegible]	[illegible]
Total Revenue	$[illegible]	$[illegible]
Ave. Revenue per Station	$11.8[illegible]	$[illegible]

COST OF OPERATION AND SEGREGATION OF ACCOUNTS.

The statement of Earnings and Expenses for the year 1908, as filed with the City, is as follows:

REVENUE—

	First 6 Mos.	Last 6 Mos.	Total
[illegible]	$[illegible]	$[illegible]	$[illegible]
Private Line	[illegible]	[illegible]	[illegible]
Long Distance	[illegible]	[illegible]	[illegible]
Real Estate	[illegible]	[illegible]	[illegible]
Total	$[illegible]	$1,[illegible].61	$2,[illegible]

EXPENSES—

	First 6 Mos.	Last 6 Mos.	Total
General	$[illegible]	$[illegible]	$[illegible]
Operating	[illegible]	[illegible]	125,986.17
Maintenance—			
Sal. & W.	[illegible]	[illegible]	[illegible]
Material	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]
Total	$[illegible]	$[illegible]	$[illegible]
Net Revenue	$[illegible]	$[illegible]	$[illegible]

An analysis of the expenses as set forth in the above statement shows that the main headings are made up as follows:

General—
- Salaries and Wages.
- Rent, Light and Heat.
- Travelling.
- Postage, Printing and Stationery
- Legal.

Operating—
- Salaries and Wages.

Maintenance, Salaries and Wages—
- Current Repair, Salaries and Wages.
- Reconstruction, Salaries and Wages.

Maintenance Material—
- Current Repair, Material.
- Reconstruction, Material.

Conduit, Pole and Roof Rent—
- Balance of credits and debits charged to this account.

Rent, Light and Heat—
- Operating—Rent, Light and Heat.
- Current Repair—Rent, Light and Heat.
- Reconstruction—Rent, Light and Heat.

Directory—
- Balance of credits and debits charged to this account.

Miscellaneous—
- Uncollectable
- General Incidental
- Operating Incidental.
- Operating, Postage, Printing and Stationery.
- Current Repair Incidental
- Reconstruction Incidental.

The other headings are self explanatory.

This classification does not follow the classification used by the Company in keeping their accounts. Without an investigation of the Company's books the statement given above would be valueless for a comparison from year to year of the various expenses. For instance, under the head of "Operating" the statement shows an amount of $125,986.17, which is made up entirely of salaries and wages, while rent, light and heat for operating is an unknown amount appearing in the total for rent, light and heat; also, postage, printing and stationery and incidental expenses for operating appear only in the total for miscellaneous. Again, the amount for rent, light and heat does not include all of the expenses under this heading, as in the amount given under "General" is included an amount for rent, light and heat.

However, the statement of the Company for the year 1908, showing the revenue and expenses, follows the same form as that presented to the Supervisors for the year 1907, which statement was submitted on February 10th, 1908. For this reason the statement of revenue and expenses of the Company for the year 1908 was submitted in the form as filed in order that it might be readily compared with the statement submitted for the year 1907.

I have investigated the classification of accounts as used by the Company, and, in general, have no criticism to make upon their methods. However, it would seem to me that the revenue and expense accounts respectively should contain all revenues and all expenses and not have, as is the present practice in the cases of directory and conduit, pole and roof rent, only the net expense appear as expense. This change would, of course, only affect the gross revenue and gross expenses, and not change the net revenue.

Following the classification used by the Company in keeping their accounts, the expenses for the year 1908 would be segregated as follows:

EXPENSES—

	Previous Month	Last Month	Total
General	$ [illegible]	$ [illegible]	$ [illegible]
Operating	[illegible]	[illegible]	[illegible]
Maintenance—			
Current Repair	[illegible]	[illegible]	[illegible]
Reconstruction	[illegible]	[illegible]	[illegible]
Instrument Rental	[illegible]	[illegible]	[illegible]
Conduit, Pole and Roof Rent	[illegible]	[illegible]	[illegible]
Ins., Personal Property	[illegible]	[illegible]	[illegible]
" Real Estate	[illegible]	[illegible]	[illegible]
Taxes, Personal Property	[illegible]	[illegible]	[illegible]
" Real Estate	[illegible]	[illegible]	[illegible]
Real Estate	[illegible]	[illegible]	[illegible]
Total	$ [illegible]	$ [illegible]	$ [illegible]

The expenses as set forth in this statement are made up as follows:

GENERAL.

The amount charged to this account is a proportion of the total general expense of the Company under the following divisions:

Salaries and Wages.

This account is charged with the salaries of the president, vice-president, general manager, secretary, treasurer, auditor, attorney, engineer, commercial, general and division superintendents and other general officers and their office forces.

Rent, Light and Heat.

This account is charged with the rent, light, heat and care of the offices occupied by the president, vice-president, general manager, secretary, treasurer, auditor, attorney, engineer, commercial, general and division superintendents and other general officers and their office forces. [illegible] owned by the Company [illegible] used for officers and employees named.

Traveling.

This account is charged with the traveling [illegible] all general officers and employees [illegible] general business of the Company.

Posting, Printing and Stationery.

This account is charged with the [illegible] printing, except directories [illegible] stationery and postage for the use of [illegible] Company, excepting that [illegible]

Legal.

This account is charged [illegible] attorneys other than the regular [illegible] Company, who are employed [illegible] service.

Incidental.

This account is charged [illegible] pertaining to the general [illegible] properly classified.

Uncollectible.

This account is charged [illegible] Company.

OPERATING.

Salaries and Wages.

This account is charged [illegible] the commercial manager [illegible] clerks and [illegible] incident [illegible] after [illegible]

This account is charged [illegible] general superintendent [illegible] traffic, traffic engineer [illegible] telegraph, traffic agents [illegible] and office forces of [illegible]

This account is charged [illegible] chief operator [illegible] attendant [illegible] the exchange [illegible] Company in handling the traffic [illegible] attendants and other exchange employees [illegible] dental to this department.

Rent, Light and Heat.

This account is charged with [illegible] care of space occupied by exchange [illegible] employees, except the space occupied by [illegible] maintenance force.

Postage, Printing and Stationery.

This account is charged with the cost of [illegible] ing and stationery chargeable to operation.

Directory.

This account is charged with the salaries of the superintendent of directory department and his office force, the rent, light, heat and care of offices occupied by same, and the cost of printing and distributing directories.

Advertising and Canvassing.

This account is charged with the salaries and traveling expenses of canvassers, except for private lines, rent, light, heat and care of space occupied by same, commissions paid for securing new [illegible] and the expenses of advertising for new business.

Incidental.

This account is charged with items of a [illegible] nature [illegible] which cannot [illegible] classified.

MAINTENANCE.

This account is [illegible] under the general divisions [illegible] current repair and reconstruction [illegible] defined as follows:

Maintenance-Current Repair.

[illegible]

Maintenance-Reconstruction.

[illegible]

INSTRUMENT RENTAL.

[illegible]

CONDUIT, POLE AND ROOF RENT.

[illegible]

REAL ESTATE.

[illegible]

TELEPHONES ON THE FARM.

BY M. S. ALLEN.

A few years ago telephones were as rare in the country as airships are today. They were looked upon as one of the luxuries to be enjoyed only by the very well-to-do in the cities and larger towns, and the few occasions country people had to employ long distance lines, with the accompanying high charges, emphasized this feeling. During the last few years, however, there has been an almost complete reversal of feeling in this respect, and there is now hardly a township in the country where there is not at least one rural line.

This line may begin eight or ten miles out in the open country and extend into a town where there is an exchange, or it may begin in one man's house and zigzag along the country roads for fifty miles, with a telephone in every farm house or crossroads store which it passes. The latter class of line is the one which has done most to popularize telephones. Each subscriber owns a share in the line and helps to build it, and each one owns his own telephone, keeps it in order, and helps keep the line in working order.

John Peters is connected to a line which is sixty-five miles long and has seventy-two or three other instruments on it. His friend, Jim Nixon, is on the same line, six miles away, and when John wants to talk to Jim, he takes down his receiver and says, "Hello, Jim," knowing that half the time Jim and most of the other people on the line are either trying to talk to some one or listening to the news of the country. If Jim doesn't answer, John rings for him, trusting to get him with only one ring, and knowing perfectly well that every person between and on both sides of them will immediately listen on the line to see what is going on. It was on such a line as this that the old lady was found knitting with the receiver tied to her head in such a way that she could overhear every word passing over the line. She was very indignant when told that her action prevented the other people on the line from ringing one another and put the line out of order so far as calling was concerned, and said she was just going to send her son to report that the line was out of order because she hadn't heard a word all the morning.

Country doctors were among the first to appreciate the advantages to be gained from rural telephone lines, and spent many days convincing their patients and neighbors that with a telephone many trips at night and in bad weather could be avoided. They were only too glad to put small five or ten-line switchboards in their homes, in which the long lines would terminate, and to do the necessary switching of one line to another for a nominal charge, because doing so insured them all of the medical business in their district, and saved them many long drives on muddy or dusty country roads. Many doctors who were located in towns of several hundred people started out with a few lines this way, and gradually developed the business until they now have exchanges with several hundred subscribers, the revenue from which makes a most welcome addition to their incomes.

The larger operating companies have recognized for a long time the necessity for the development of country lines about their exchanges and toll stations, but have been unable to accomplish this development because of the long lines required and also because the people in the open country either could not afford to pay the rates such service would require, or did not realize that telephone service was worth the price asked. A solution to this problem has been found, however, and it will be only a short time comparatively before there will be just as many telephones per capita outside of the cities and towns as there are now in them.

The plan provides that a group of people living along a road shall get together, organize a small mutual company, cut and set their own poles, install their own telephones, string their own lines up to the exchange limits, and there connect with the operating company. They pay a nominal switching charge for the purpose of talking with the subscribers to that exchange, and regular toll charges from that exchange on long distance calls through it to distant points. This enables the people in the open country to enjoy the same telephone service that their city friends have, to talk to their relatives or brokers, to buy the necessaries of life, sell the produce of the farms, or, when they are in the city, to call up and learn if anything is wanted at home before they start back again.

When these country lines were first built, the work and material were of the crudest sort. One line consisted of a single fence wire, strung from house to house, and the telephones were nothing more than empty tin cans with an end of wire stuck through the perforated bottom, and fastened there with a penny which had a hole in it, through which the wire protruded. These telephones were like the ones children make when they are running a string forty or fifty feet from one window to another, but this line was miles long, and the instruments were unprotected by lightning arresters. One day when some one was trying to use the line during a thunder storm, lightning struck the line and killed him. That was the end of "penny telephones" and the beginning, in that section at least, of knife switches with which to cut out telephones during thunder storms. These switches were just as crude as the penny instruments, and consisted of large, heavy, kitchen spoons. A nail was driven through the bowl of the spoon into the wall, and the line wire terminated on it. At the lower end of the spoon handle were two more nails a few inches apart. To one nail the telephone was connected and to the other the ground wire. There was enough spring in the bow of the spoon handle to make a pretty good connection, and the switches did the work for which they were designed.

Nowadays, however, telephone lines and instruments are of the best. Fence wire no longer appeals to the farmer because it is cheap, for he realizes that a well built line of good material will not only give better service during its life, but will last a great deal longer than a poorly constructed one of cheap material. While long lines are still used, they are cut into sections, or terminated in small switchboards, and the number of subscribers on a line is usually from six to fifteen. Many of the lines are metallic circuits of No. 12 BB wire, and brackets and insulators are used instead of porcelain knobs. The material for such a line, exclusive of poles, costs only about $14 per mile, and as the subscribers usually average one per mile and can cut their poles on their own places, the expense per man is not great. The best telephones, with all the material necessary to install them, can be purchased for $13 or $14 per set, making the initial cash investment for an instrument and one mile of metallic circuit material only about $27.50, or, if a grounded line is strung, $20.

This puts the cost of telephones within the reach of almost every one, and at the rate at which they are being put in, it will be but a short time before a person can go into a farm house in any part of the South and talk to any part of the country.—Southern Electrician.

Pacific Radio-Telegraph Company, Ltd., was organized in England last month to acquire powers for the construction, maintenance and working of a system of intercommunication by means of radio-telegraphy between the islands of the Pacific Ocean and the territories of Australia and New Zealand.

A mail subway is to be built between the various post-offices and railway stations of Berlin An automatic system of electric cars without motormen will carry the mail at a speed of twenty-five miles an hour.

Telephones in safe deposit vaults have been installed by a New York bank for the convenience of patrons who wish to consult financial men without taking their securities from the vaults.

PROCEEDINGS PACIFIC COAST ELECTRIC VEHICLE CONVENTION, SAN FRANCISCO, FEBRUARY 19-20, 1909.

(Concluded.)

DISCUSSION ON "RELATION OF CENTRAL STATIONS TO THE AUTOMOBILE BUSINESS."

The Chairman: This subject is open for discussion.

Mr. C. T. Ryland: In the future the central station man might own all the batteries and the owners the vehicles. The central station man or some big concern would rent charged batteries, taking them back when they were discharged and replacing them by others. He would then have standard sets; the owners would then get rid of the bugbear of taking care of the batteries. If the big companies handle the batteries that way, a big part of the business would be taken care of automatically.

The Chairman: That might be the solution of touring with electric automobiles, if charging stations were established and the companies owned the batteries.

Mr. F. T. Kitt: I think there is a storage battery company that makes a practice of that, and they trade them as they do "Prestolite." I think for six-cell spark batteries they renew them and give you another battery. It is not likely that the central station could afford to operate that way with a vehicle battery because it would be misused. They would get into many difficulties.

Mr. G. E. C. Holberton: While I think that Mr. Kitt is right in what he says, I will say that central stations will welcome any device that will tend to flatten the load curve. We have made already special prices for charging automobile batteries. But I will say that in California the price does not appear so attractive, because here rates for general power use are very much lower than in the East. I think that is true all over the Coast. From what I can gather from people who come out from the East our rates are now very low. I think that we cannot adopt the suggestion of having any clause in the contract for using current off the peak. The only way is to use two meters and charge a certain rate during certain hours, and then if they use current off the peak they will get a lower rate. The rate in Oakland for automobiles is five cents, and then from that there is a discount for consumption. But in San Francisco the lighting rate already is scaled down to four cents. To go below that would be a very low rate. So far we have had very little call for charging in San Francisco. Whether that is due to the fact that the hills are against the use of the electric I do not know; I presume it is. As far as our own system is concerned, I think Oakland has been the largest field so far. I believe that Oakland, Stockton and Sacramento are all good places for the introduction of electric automobiles, for many reasons the conditions there are ideal. The electric vehicle, it seems to me, appeals most to those who desire to operate their own vehicles, and particularly ladies, while shopping. Even the owners of larger gasoline cars also have their electric runabouts. If there are any questions that any of the gentlemen desire to ask as to our attitude in the matter I would be very glad to answer them. As I have already stated in general we welcome the electric automobile, and anything else that will consume current.

The Chairman: We understand that any central station company would welcome the automobile if the automobile would come into its town and use current, but I would like to ask what their attitude is toward the electric automobile—that is, do you believe that it is a success? If you do not now I certainly think you will when this convention is over. We believe that it will be such a great advantage to the central station that the central station people will not only welcome it but take means to bring it about—in advertising; and first and foremost, by purchasing electric automobiles for their own use. They are especially well situated to do that for the reason that they have current which they can use for charging and on which the profit is, of course, eliminated. Those are the points that we would like to bring out here—that the central station should take means to push the use of electric vehicles just the same as they do flat irons, curling irons, sewing machine motors, and so forth, which really consume a very small proportion of current.

Mr. A. C. Downing: One of the best illustrations of power stations taking hold of this matter is the Union Gas & Electric Company of St. Louis. They have taken on the agency for three electric machines, operate a large garage in connection with their business, and have developed the electric automobile business in St. Louis to a great extent, in fact, three years ago there were not six electric machines; today the Union Gas & Electric Company are caring for 75 every night and another concern 125, and many are charged at home, showing what can be done in three years. They advertise it throughout the city with electric signs, large sign boards electrically lighted and all through their different advertising mediums, just the same as they do with their curling irons and smaller apparatus.

Mr. W. L. Harvey: I would like to ask Mr. Holberton what he would figure it would cost to charge an ordinary automobile at the rate charge in San Francisco, say, put the rate at 5½c per kilowatt hour. I ask for this reason, that in Buffalo their rate is 8½c per kilowatt, and they figure up the expense at about 40 cents a day. I am taking care of two machines and I have taken particular pains to watch my bills and I find that my two machines cost me only about eight dollars a month to charge, that is, the increase in my bills has been about eight dollars per month, using direct current. This includes rheostat losses. The average run of an automobile in San Francisco is thirty miles per day. There are days when they do not go out, and sometimes they need a quarter of a charge and sometimes a full charge, but I think the figures are right, because they are given to me by a large company in the East where they are taking care of 150 machines, and figuring on my gasoline expense I would accept those figures as correct.

Mr. W. D. Vance: You can use up the full charge in thirty miles.

Mr. W. Harvey: We realize that. In a gasoline car I have put a man in charge who used 26 gallons of gasoline between here and San Leandro. I can put another driver on there that can go clear to San Jose on 3½ gallons. The same proposition applies to the electric vehicle. I have found out that you have got to make a machine so absolutely fool proof that no fool, no matter how big a fool he is, can hurt the machine.

The Chairman: I am glad Mr. Harvey brought out the point that his experience shows that the average vehicle goes thirty miles per day, because in my paper this morning I made the offhand statement that most of the gasoline machines used in a city could be displaced with the electric vehicle, and that seems to be a conclusive argument.

DISCUSSION ON "THE VEHICLE MOTOR."

Mr. A. C. Downing: Will Mr. De Remer give a comparison of the electric motor in horsepower to that of the gasoline car? We are quite often asked by a prospective customer what the horsepower of our cars is. We answer him that it is not rated that way but that we have a motor of three or four horsepower as the case may be. He in turn says that a gasoline car of the same capacity has fifteen or twenty horsepower.

Mr. J. G. De Remer: In that connection, as I stated in a part of the paper, the rating of the motor is not limited, as in the case of a gasoline engine, that is, the motor will take for a short time almost everything that can be put on to it, and the rating is dependent upon the time of operation or upon the demand. For instance, you can climb a very steep hill and the motor will take several hundred per cent overload for a very short time. The rating is determined by the temperature raise only. The sizes run from about 1½ up to 5 horsepower per motor, with the possibility of a double motor equipment, or a single motor if that is sufficient.

The Chairman: The gasoline engine for its horsepower depends upon a certain area of piston and a certain pressure, and of course as the speed is reduced the power is reduced, whereas, with the electric motor, the battery efficiency is increased as the speed is reduced. It simply depends upon the resistance of your armature how much current you can get through. So that the relation between torque and power is quite different with the electric motor than with the gasoline motor, in other words, the electric motor is capable of doing a tremendous amount of work on hill-climbing which the gasoline motor would not be able to do with the same rating.

Mr. R. M. Alvord: I have seen quite a number of articles lately about a transcontinental road electrifying the load over the mountains. The same thing would apply with the gasoline engine and the electric engine. They found that on their high grades the electric motor worked better than the steam locomotive, and I think the same thing would apply with the electric motor as compared with the gasoline motor, that the economy would be much greater on the high grades.

Mr. G. A. McDougald: One of the greatest features is that the transmission is eliminated. There were some statistics gathered in the taxicab business showing that an 18-horsepower gasoline rating produced at the wheels only 3¼ horsepower, the rest was lost.

Mr. W. W. Briggs: That is an intricate problem that the gasoline men have always had. I do not understand that a gasoline engine has any fixed horsepower. When it is rated at 20 horsepower it is only at a fixed engine speed. The same thing pertains to a railway motor; it is that horsepower at a certain fixed number of revolutions, which is constantly varying. That developed in the expansion of the electric railroads, as the business developed. The old electric railway manager got horsepower fixed in his mind and it took quite a long campaign of education to disabuse his mind of the horsepower rating being applicable. As Mr. De Remer mentioned in his paper, the general method of determining a railway or vehicle

motor rating is by a time and temperature curve. Take the square root of the mean square of the current consumption and assume that that value has continuous application for a certain length of time which would heat the motor only to safe limits, and consider that the motor rating. As a result, the apparatus has been very much more satisfactory than in the past, because they found out what was needed and put the right motor on. I am satisfied that the electric vehicle men will have to carry an educational campaign of the same kind when they bring up the question of horsepower rating, because as a matter of fact, "When is a horsepower?"

Mr. W. L. Harvey: I have found that a three-horsepower motor will perform the same feat as a 24-horsepower gas engine. We have a three-horsepower motor in an electric vehicle and we do certain things that the gasoline engine people consider very good results.

Mr. J. G. De Remer: Can you attain the same speed?

Mr. W. L. Harvey: Yes, we can maintain the speed—28 or 29 miles an hour. A great many people tell me about riding 60 miles an hour. I have done it, but before I did it, I thought I was going that fast. We have a good driver going through the park at night when everybody wants to speed all the way, and all he does is to open up the muffler and make a noise, and he is going fast. That in plain English is what most people think speed is. You can take a three-horsepower electric motor and accomplish the same result without making any noise. I have seen in hill-climbing and so forth where a three-horsepower electric motor will do everything that a 20-horsepower gasoline car can do.

The Chairman: In other words, for a gasoline or electric car in a hilly city like this it is drawbar pull and not horsepower that is desired.

Mr. W. L. Harvey: Yes. They used to rate a gas engine 24 or 30. I believe there is one in the market now that rates 35-60; that is, at certain speeds of the engine and under certain conditions it is 35 horsepower, and when you give the full throttle she will develop 60 horsepower. How much power she transmits to the wheels is another question, but that is the rating.

The Chairman: I would like to have the point discussed, in regard to the consumption of energy running up a very steep hill; that is, with a very heavy drawbar pull, whether it is going to take a very large proportion of the energy of the battery to do that, or has the motor such a characteristic that you do not discharge the battery an unreasonable amount.

Mr. J. G. De Remer: I can say on that point, that the efficiency curve up to the very limit of the motor operation is fairly well maintained, that is, when taking the current which will cause it to raise to the maximum allowable temperature in a very few minutes. The efficiency drops off but a very little per cent in the maximum value. That would indicate that the power consumption is as small as can be.

Mr. A. C. Downing: The general tendencies among the constructors of automobile motors has been towards the series wound motor so that it will take care of itself on a hill. The compound or shunt wound motor tries to negotiate the hill at the same speed as on the level, thus naturally causing a great consumption from the batteries and works a hardship in that direction. The Elwell-Parker people, the manufacturers of practically the only motor of that type, have changed their motor lately and have gotten away from several of those features that they embodied in their earlier motors. Their experience was direful in some cities where the conditions were severe.

Mr. W. W. Briggs: There is a matter in this connection that I have heard of recently that might be of general interest particularly in commercial vehicle business. The manufacturers are working on a controller which is specially adapted to hilly locations. Mr. De Remer touched upon it briefly. We have developed such a controller and experimented with it and it is effective when placed in the hands of a fairly skilled operator, such a one as would ordinarily drive on a commercial machine in contradistinction to a lady. This controller will increase the field of operation of the commercial vehicle and also reduce the wear and tear on the vehicle in braking, that is, when a man comes down hill with a heavy load by the use of this controller the excess of consumption of current on the uphill is partially compensated by regeneration.

Mr. F. W. Pfaffman: Reference has been made to a compound motor. We have obtained six speeds, two of them in re[illegible] and the third speed is what we call the normal [illegible] speed in coasting down the hill, the ammeter shows [illegible]. We find that the shunt is a very useful [illegible] if it is properly made. The results are marvelous. The application of the electric brake in coasting down hill is different from what it is in most machines in that it does not catch the machine suddenly no matter what speed you are going at. It pulls you down gradually at high speed or low speed. It is possible to go down a very steep grade at a high speed and catch your machine at just as slow a rate as you wish by means of this brake. It is unnecessary to use a foot brake.

Mr. F. T. Kitt: Is there any draft on your batteries?

Mr. F. W. Pfaffman: There is possibly two amperes in the use of the brake; it is scarcely noticeable; it is simply the armature being held.

Mr. F. T. Kitt: I understood you to say that the ammeter showed in the opposite direction, showing that the current was going into the battery instead of out.

Mr. F. W. Pfaffman: Yes, I never noticed that except for a few minutes. It could scarcely be taken into account; it was practically of no value whatever. It only occurred when I ran with the field and the batteries in series. Of course, I am talking from the standard of the compound wound motor. I would like to discuss it more fully and give you all the facts, but I do not know the operation. I can only state the facts; I am not an electrician.

Mr. W. F. Lamme: With reference to the question just brought up about the braking, I really think there is some use made of it. I have never seen it. It is natural for it to be so. I do not think that this would occur except when the car was running at a pretty high speed. When that occurs you pull your lever back and your current will die out. You have still some residual field and that would produce some braking effect. It would not be reasonable for it to be made in any other way. As to this series question, undoubtedly the series motor is the most efficient motor and the easiest motor on the battery that can be made. The little equation that the torque is equal to the product of the magnetic field by the current running in the armature shows this. The magnetic field is made by the main current; therefore, the stronger that current, the less the total current necessary, for at the same time the speed of the apparatus is decreased. Both of these points result in less energy from the battery for a certain required torque. The compound wound motor is a little worse in that respect; it takes more current; and the shunt wound is the worst motor of the three. For instance, in going up a hill, not taking into consideration the saturation question, if we have a shunt motor, it will take, for instance, a hundred amperes; if we have a series motor it will take fifty amperes; in other words, doing the same work, the series motor is the best motor we can get for that work; and for automobile cars it is best, especially because we are limited in our battery capacity, and the weight of the battery is an important point.

The Chairman: I want to ask Mr. Lamme, on a level road what is the best motor?

Mr. W. F. Lamme: If I had a choice I would take a series wound motor for the reason that the starting ability is greater; we could start easier; and our starting devices could be made more simple. With a shunt, we could not start so well because we could not throw the whole current on the armature. In some series wound motors it is found desirable to use a little series resistance in connection with the field and the armature too. This will give a little nicer starting condition. Some people object to the little jerk we have; a little resistance in the circuit will flatten that out.

The Chairman: How about the running efficiency?

Mr. W. F. Lamme: A series motor has very frequently a sharper high efficiency point. A series motor has one point where it will run fully as high as any shunt motor, but it tapers down unless it is specially designed. A shunt motor generally ridges out or flattens out at the heavy load, because there is less copper loss. In a series wound we have copper losses both in the field and in the armature. The copper loss goes up with the square of the current.

The Chairman: Is not the attempt in the compound motor to compromise and get the best running conditions on the average?

Mr. W. F. Lamme: Possibly. In regard to the point you bring up on the level road, I think probably with a compound motor you get pretty fair results. You can do this, make a motor with very strong winding, which would be used in starting and then permit the shunt to build up afterwards, giving a combination of the two. With the shunt motor we can feed back into the battery sometimes, down a grade. But there is not so much gain as we think. I think we one time figured on that point on the Southern Pacific Railroad coming down this side of the Truckee grade; I think we gained something like 10 per cent of the energy. It hardly paid for the computation.

The Chairman: Would it not possibly obtain that in a very hilly town and it would be best to have a series motor and perhaps in a level town like Chicago to have a compound motor?

Mr. W. F. Lamme: Undoubtedly. There was another point brought out in the discussion which hinges upon this, that is, the weight of the motor. As I said before, the torque is equal to the total magnetism multiplied by the current. Notice the two terms, the magnetism and the current. You can make the magnetism large and the current can be small. That is a very important question when you come to the battery. But to make the magnetism large you have got to have a large iron circuit;

that is, you would have to have a motor with more weight than another motor might be. The question raised there is, are we reaching the greatest efficiency with reference to the size of the motor and the battery; for instance, if we would add 50 per cent to the weight of the iron in the magnetic circuit—take as an example a 200-pound motor and a 1,000-pound battery—probably we could add 5 per cent to the battery. That would mean that we could reduce the battery 5 per cent. Then we would have a better combination than in the first place, and the total weight of the car would be the same as before; but we would have less current consumed. I believe this is an important point that has never been thrashed out.

DISCUSSION ON "THE COMMERCIAL VEHICLE."

Mr. J. M. Mitchell: I would like to ask what you would consider the ordinary life of the electric automobile, everything else being equal?

Mr. A. C. Downing: Of course it is a proposition on which all will differ. Today even in Oakland there are some little electrics running on the street that were manufactured seven years ago. Outside of tires and batteries I presume the parts are the same as when the car left the factory, outside of those being replaced in wear and tear. Down at Pasadena the other day there came to my notice a little wire wheel Waverly with one of their old type A motors. The car was identical with the way it left the factory, showing that in that stage of development the car gave six or seven years' life, so that today we ought to get ten or fifteen out of the vehicle itself.

Mr. J. M. Mitchell: A commercial vehicle?

Mr. A. C. Downing: The commercial vehicle's life is figured at ten years with a depreciation of 10 per cent, the battery and tires separate.

Mr. J. M. Mitchell: I have been talking that the average life of an electric was about three times that of the gasoline cars. Is that right?

Mr. A. C. Downing: You are on the right track.

Mr. J. M. Mitchell: I have been also saying that the up-keep would be about one-third.

Mr. A. C. Downing: The application or service rendered would be the governing feature as to the up-keep. The comparison between the cost of up-keep between electric and gasoline would be hardly fair. It would be the same as comparing the cost of up-keep on the electric and that of a horse. The radius of mileage is so different that it would be hardly fair to make a comparison. But taking identical service over a period of five years, I think then that you would find your saving anywhere from 25 to 30 per cent, as you say.

Mr. G. A. McDougald: I would like to ask if the depreciation has been figured on the battery on the commercial car.

Mr. A. C. Downing: In figuring the depreciation the service also enters. For ordinary delivery work we figure 75 per cent each year and on heavy work we figure 100 to 125 per cent. That includes the replacement of large plates, the expense of washing and renewing the plates at the end of the year or as many times as they have to do it.

The Chairman: I might mention that the renewals of batteries really should be figured with reference to the ampere hours, discharge, or perhaps in charges and discharges. If the battery is completely discharged every time, then it will be with reference to ampere hours discharge.

Mr. G. A. McDougald: Have you any data on that question of the depreciation?

Mr. A. C. Downing: We have a great array of figures from various cars under various conditions, and would be pleased to go over them with you any time you would like to talk it over. Most of them are compiled from actual service; some of them are computed; but as I stated in the paper, knowing now about the battery entire, it gives a pretty fair chance to figure the exact cost of operating, provided we know the conditions. In examining concerns' delivery systems we go to such an extent that we guarantee that the cost of up-keep will not run over so many dollars per year after such an investigation has been made. With a gasoline truck it would be pretty hard to do that and come anywhere near it.

Mr. I. G. Perrin: My experience with electric truckshas been limited almost altogether to light delivery wagons and more particularly in Detroit, where five years ago there were perhaps a dozen light delivery wagons and they were decidedly successful even at that time. Those in use there were mostly of the Pope-Waverly type. They gave very good service, but the electric truck that we have now is far ahead of them.

The Chairman: Can you give us any data or ideas as to the relative saving in using electric trucks as compared with horse-drawn vehicles?

Mr. I. G. Perrin: The cost of operation would be just about one-half what it would be to operate a gasoline wagon of the same capacity for the same purpose. On the other hand, we have maintained that one electric delivery wagon of a given capacity would do about twice the amount of work that could be done by a horse-drawn vehicle. That does not give any accurate idea as to what the cost per ton mile might be.

Mr. R. M. Alvord. I would like to ask in regard to the capacity of the delivery wagons, a comparison on something between a thousand and two thousand pound for delivery work.

Mr. I. G. Perrin: The delivery wagons have a capacity of about 1500 pounds. That is the size that will come into use first, perhaps, and be used more than any other. They represent a very good example of modern electric commercial delivery wagons.

Mr. A. C. Downing: The mileage of a commercial vehicle will vary according to size from one renewal of the new batteries to two renewals; on the light delivery wagons with approximately 8000 miles, down to the five-ton truck with 4500 miles, and be graduated with the increase of the weight.

The Chairman: That does not mean an entire renewal, all plates?

Mr. A. C. Downing: That means an entire renewal. Of course there are instances where their load is less and their life is naturally going to be greater and the number of miles consequently would be more.

Mr. F. W. Pfaffman: What proportion of the work can the electric installation accomplish over the installation of horses?

Mr. A. C. Downing: The number of parcels delivered in one case was the same, they had seventeen teams and wagons, and that was being done by ten electrics were calculated to do the same work. Where the great saving was effected was in the number of drivers. So they had a saving of seven drivers and seven boys helping. One way that they accomplished that was by starting to deliver at 8 o'clock in the morning. They would cover their route by 10 and were back and took a short load at 10.20. Then they would get back to the garage and change their batteries at noon and start again at 1.30. They made four trips a day where the horses had only been making two. That is one of the points in the delivery question. In driving along with a horse on a level it is hard for a machine to make much better time unless it comes to a long jump, but when it comes to the hill work and coming down we are able really to accomplish more in Kansas City than we would be in cities that were more level. The service on the horses was so much severer that they could not stand it.

Mr. G. A. McDougald: How many miles on one charge would those cars go, how far would they travel and what speed would they make?

Mr. A. C. Downing: The car made 35 miles at a speed of 11½ miles with a load and they make about 12½ miles empty. The way they were working it they were making only about 24 or 25 miles on one battery. We found in experimenting that the mileage they wanted was just a little bit more than one battery would accomplish.

Mr. F. T. Kitt: I would like to ask Mr. Downing or anybody that has had experience with four-wheel drive as to the advantages of that, if there are any?

Mr. A. C. Downing: There are two, the couple gear and the Auto-rapid transit, formerly of Detroit, but they are out of business. The current consumption is very low. The very fact of its having driving traction at each wheel necessarily brings about a greater mileage, but they have their drawbacks that I think are greater than the increased mileage would be of benefit. I would like to see the couple gear people sell a number of trucks. The fact that you have a special motor in the wheel getting shocks directly is bad. It is bad enough for the motor to have to stand it when it has the protection of the springs. In St. Louis they had the trouble with their armature shaft springing. The wheel has a sort of a bore-pinion arrangement. Then a little pinion around the armature set, and as the armature turns that pulls the pinion and pulls the wheel around; and if they get a shock or jar you spring that shaft enough to allow the gears to jump and cause great inconvenience to the people who own the truck. It may be that in their later designs they have been able to overcome that.

The Chairman: Mr. Lamme, perhaps you can tell us some of the advantages and disadvantages of mounting the motors in these two ways, with spring suspension and without spring suspension?

Mr. W. F. Lamme: I have had little experience along this line. In some few large equipments we have spring suspensions. The New York, New Haven & Hartford Railway had the spring suspension motors of that type and there did not seem to be any trouble with them. For automobile work, though, I think we ought to get as near simplicity as we can. They have some advantages, as there is no doubt economy of current. That is not because of suspension but because the motors used have certain parts that give an advantage in the way of current. For truck purposes I believe the solution of the question is going to be in the use of one motor, one large motor. If by some means we can get a drive to the wheels this will give us the best result in the way of economy. This is plain because with one motor we can get better efficiency than with two or three or four; that is, for the weight, and all this tends

to economy. I think this will be the final solution of the question—one large motor built very efficiently will give you all the torque you want for all the conditions prevailing. That is all I have to say.

Mr. A. C. Downing: The General Vehicle Company are using that type of construction—one motor—but there is a question in the minds of the engineers as to whether they would rather have another motor to work with than a differential. The efficiency I think of the two would be about the same when it comes to the transmission of power or the loss of transmission, rather, and we know what a motor will do, and there is still some experimental work to be done on the differential, particularly on the counter shaft, to get them as reliable as the motor would be.

Mr. A. C. Jones: It seems to me that if there was no trouble entailed in transmission by the use of more than one motor you would be able to operate at a great deal higher efficiency on account of the fact that on light loads you would have the advantage of operating small motors at full load. Whereas, if you had one large motor under light conditions you would be operating under far less than high efficiency. So it seems to me that two motors would be better, provided the transmission system could be simplified.

Mr. A. C. Downing: I do not quite get your point. Suppose you had four motors, would not their aggregate capacity be the same as one motor?

Mr. A. G. Jones: It seems to me that if there was no trouble and say you got a five-ton truck and you only had one ton on that truck, you would be operating that motor far below its normal capacity and of course the efficiency would be a great deal lower on the lower part of the load curve than it would be if operating at normal capacity, on the other hand, if you had two motors or four motors, would it not be possible to use the two smaller motors on light load operating at nearly full load, cutting out the others?

Mr. C. T. Ryland: I think the application of the electric circuit to cut out the other two motors would overbalance the advantage. The advantage of the larger motor is that the motor itself is more efficient, but the disadvantage of the single motor is that the gearing from the motor to the drive wheels is more inefficient, so that if you had a motor on each wheel, while you are losing efficiency on each motor, you are gaining in effciency by cutting out gear and shaft and belt, which is a source of annoyance greater than the two bearings and a pair of brushes on the motor.

Mr. G. A. McDougald: It is customary now to use gears with either one motor or two. With one motor the up-keep and trouble is reduced.

Mr. A. C. Downing: There is one more feature in using a single motor, particularly on large vehicles, when it comes to the designing and clearance available under the single motor, it would have to be of such dimensions and the platform to carry it and give clearance would have to be so high, a concern with trucking to do would not entertain the purchase of trucks for that reason. There are objections even with the smaller motors where we have the body only a few inches from the ground, and particularly on the Coast they are used to the drop axles and goose-neck wagons, and it would make it a harder proposition with a single motor.

Mr. C. T. Ryland: Of course the size of the motor depends upon the relative speed of the armature and field. Might it not be possible to get up a motor in which the field would rotate in one direction and the armature in the other, and in that way double the speed, and consequently obtain a smaller and lighter motor of greater efficiency, because if we run a motor at 600 revolutions it is not as efficient and it is heavier than a motor running at 1200 revolutions. The only obstacle is in leading the current into the brushes which would be rotating, if w rotated the field.

Mr. W. F. Lamme: That is the same old question—what speed is your motor running at? When you run your field at 800 revolutions and you run your motor at 800 revolutions, you are running at 1600 revolutions. The speed of a motor is fixed largely by the speed of the alternations, or alternations that we experience in commutating. That is one of the great difficulties, and that is one of the limitations. I think that trouble would be just as great if we used a high speed motor.

Mr. A. G. Jones: I would like to ask Mr. Lamme about the efficiency that Mr. Alvord was speaking of in the shunt motor and the series motor. Is not the characteristic very similar, the characteristic efficiency curve?

Mr. W. C. Lamme: They are somewhat alike. In a series motor the armature conditions are in the shunt motor, but the field conditions are different. One is constant and the other is variable. This makes the difference. The shunt motor generally has a longer, smoother efficiency curve, that runs out straighter on the heavy load, while the series motor comes down somewhat at the outer end. This is due to the copper losses in the field. The copper losses in the field of a series motor go up with the current. In the shunt motor they do not vary to a great extent. This is the chief difference.

Mr. G. A. McDougald: I would like to ask what the difference in efficiency is between a five-horsepower motor and two $2\frac{1}{2}$-horsepower motors.

Mr. C. T. Ryland: We have a single motor operating by storage batteries, and we either have to throw out cells, put in resistance or do something of that kind in running slow. In street car practice you put the motors to start with in series and afterwards in parallel. Now, if we have two motors or four motors—two probably would be better—would it not be better to have a series parallel controller and in that way work our batteries at higher efficiency?

Mr. W. F. Lamme: In many cases we take the batteries and on the low speed we run them in parallel and on the high speed in series. We do that with great refinement and we get fully as good results or even better, for in the automobile we can interconnect our field and armatures and batteries so that we never need any resistance at all and get pretty good results. When we use no resistance we get our maximum efficiency.

The Chairman: The beauty of that scheme is, when we divide the battery into two or three or four parts, with every division we multiply the amount of current available, so that we can increase the torque without increasing the number of cells.

Mr. F. W. Pfaffman: Would that not unbalance the battery, drawing upon them unequally?

The Chairman: If the resistance of all the circuits are alike and the connections are good the discharge should be very nearly equal. Furthermore, suppose one set of batteries has discharged a little more than the other, its voltage would be lower and hence it would do a little less work and the other would catch up to it. If these trucks are taken care of in a garage intelligently, there is no reason why they should get out of balance permanently. I know that question has received a great deal of attention in connection with pleasure vehicles. Formerly that method of control was used. Now, the cells are operated all in series. Probably one of the reasons for that is that a great many pleasure vehicles are taken care of by the owners, and they would give absolutely no attention to the relative condition of the different cells.

Mr. C. T. Ryland: How are pleasure vehicles controlled?

Mr. F. W. Pfaffman: On the old Columbia, the first electric automobile, there were four sets of batteries which were connected, four in multiple, on the first notch, the second notch doubled the voltage and the third doubled the voltage again by connecting them all in series. On some of the modern cars they have two sets of batteries, one in front and one in back, half in each compartment. On the normal speed they run them in parallel. The first speed throws a small resistance in series; the second notch of the control cuts the resistance out; that is the normal running speed; and they have an emergency speed by throwing all the batteries in series, without any resistance in circuit.

Mr. G. A. McDougald: I will ask Mr. Downing how the electric truck is controlled.

Mr. A. C. Downing: The battery is divided of course. For the first and second speed the battery is in parallel; for the third and fourth speed they are in series, and then the connection of the field in series on the first notch and parallel on the second, and again on the third, and parallel on the fourth. Your batteries, of course, being divided, the first and second being the same and the third and fourth being the same.

The Chairman: The two most interesting points brought out are as to the results obtained regarding the relative expense of horse-drawn and electric trucks. That seems to be convincing. And in addition to that, the hill-climbing ability of the electric truck. For instance, in Kansas City the electric truck has been more successful in replacing horse-drawn vehicles than in cities having level streets. That would seem to be interesting to San Franciscans.

DISCUSSION ON "THE ELECTRIC PLEASURE VEHICLE."

Mr. W. D. Vance: One of the principal obstacles in the sale of pleasure vehicles is the promise that the newspapers are continually putting forward of a 200-mile battery within the next six months. Another is the high price of the first-class electric pleasure vehicle. People have not been educated to the point where they realize that the electric pleasure vehicle is a practical machine. The ordinary person regards it more as a woman's plaything than anything else; and I think if we are going to form a permanent organization here one of the main ideas should be to distribute, for instance, the minutes of this meeting or other educational matter that we might get together, broadcast to people that might be interested in the subject. They are all afraid to tackle the proposition because the electric vehicles that were gotten out a few years ago we all know were a failure and people have to be enlightened on the subject and shown that the electric vehicle of today is a success in every way with regard to economy of operation.

Mr. G. A. McDougald: The principal objection that I have heard about electric cars is in regard to the hills. If it can be impressed on the public mind that an electric car can climb a

hill I think we will have taken a long step forward. Most everybody says they cannot climb a hill, and they do not know whether they can climb a hill or not.

Mr. A. C. Downing: In reply to Mr. Vance: The impression the public have of the electric vehicle is purely a matter of education as you say, and it is a local education. Just 400 miles from here, at Los Angeles and Pasadena, there are more electric machines in operation per capita than almost any locality in the United States, which means, first, that their local conditions were favorable. The introduction of the electric automobile in cities where the conditions are adverse is merely up to some firm or number of firms in putting the subject in a proper light before the people. That is clearly shown in Pittsburg. Some number of years ago a man by the name of Brown—he is now down at Los Angeles handling the Baker—had a demonstrating car. He rode around the streets all the time. People noticed him; he had a sign on the side of the car; and he made it a point to work the hills. He sold one car in about five months. The firm back of him conceived the idea that somebody would have to break the ice; and as a result the first year he sold 18 cars in Pittsburg. Of course, that is very few for the population. The next year he sold 35 machines. That opened the eyes of his competitors, or in particular the gasoline men, and they commenced looking up electric agencies. The next year Mr. Brown sold 50 cars and a competitor sold about 150. He was the one that was the pioneer and did the missionary work, he led the way for the others. That is the same thing that must be done in San Francisco. We must all pull for the electric automobiles. It will do the work over these hills. Of course, we cannot go straight up California street every day. If a person wanted to get out Pacific avenue or Jackson street or some of those districts, he can run out Golden Gate and up Fillmore and only have three or four squares of steep grades to negotiate. The same would be true coming back; there are ways around. You find that true because in grading the streets they have figured on that to a greater or less extent. For instance, in Seattle the grade of Queen Ann Hill necessitated their constructing a road of less grade up that hill. There is for the street cars what they call the counterbalance going straight up; but none of the vehicles use that counterbalance hill for driving. So that these conditions are never so severe but what the electric automobiles will cope with them, and it is merely up to us and those interested in the electric automobile business to camp on the trail, demonstrating, talking, and letting time prove our statements. As to the publicity, there is not the field for the notoriety work that there is in the gasoline car, because our mileage radius limits and cuts out the possibilities for touring and harem-scarum conceptions of some riders' minds, so that it will have to be money expended in manners peculiar to each man's business. The Studebaker Company—not wishing to be personal in the matter or applying to them particularly, but as one of the factories in the East who have conceived that idea—wanted me to come out here and do missionary work. It is pretty hard for a fellow who has been selling cars every year in numbers to come to a field where there are not many sold, but still somebody must do it, and I hope to accomplish results and bring this about by mixing with the people and with the trade, helping them with what I know and gaining information from them. The control of statements regarding the car is something that is impossible, but we want to try to be as truthful regarding the capacity and ability of the car as we can, and gain the confidence of the people.

Mr. F. W. Pfaffman: In regard to the remarks of Mr. Downing concerning Los Angeles and Pasadena and the popularity of the electrics in those regions, I would say that aside from the favorable climatic conditions, the presence of electrics down there is due to the men who have introduced them. For instance, Mr. Braley of Pasadena I believe had no encouragement whatever, but he simply went in and sold the machine. He is is the kind of man that the public would have confidence in; they would accept his statement. He told me that he sold 96 cars the first year.

Mr. W. N. Stevenson: Four years ago last month there were 43 in use, and all through Southern California Mr. Braley has placed 500 cars. The people take very much to the idea of an electric runabout for pleasure work in that part of the country. We have cars there—one five years old—just as nice cars as the new cars; not quite as stylish as the new cars, but they have been operating for that length of time. There does not seem to be much objection to the electrics. We have a 27 per cent grade, and if any one has a doubt about their hill-climbing ability, we can demonstrate it to them right there.

Mr. I. G. Perrin: In connection with what Mr. Downing said, I think a great deal might be accomplished by an organization of electric automobile dealers in starting and promoting a sort of publicity bureau, to set forth the facts as they are, being very careful not to overstate or exaggerate on the possibilities of the electric car. If a publicity bureau were started in that respect so that the public might have a reliable means of learning what the electric car was and what it can do and also the expense of operation, I think such a thing as that might accomplish a great deal to further the interest of the electric automobiles, particularly in these parts where it is more or less new and there is a question in the minds of the public whether or not it is thoroughly practical in every way.

Mr. F. W. Pfaffman: Just one point, that is, that a large percentage of the prospective customers do not make up their minds as quickly as a man purchasing a gas car. All of the agencies should take care not to create a doubt in the mind of that particular purchaser or prospective customer as to the practicability of an electric vehicle. We should all try to boost and not be knockers. You can very readily spoil the sale of an electric vehicle by creating a doubt in a purchaser's mind as to whether a car is a success or not. A person can very justly say: "This man said so-and-so derogatory of that man's car." The other man comes along and says likewise of that car. That has created a suspicion in that person's mind and many times they have given up the idea of purchasing an electric and bought a gasoline. We should not try to bring out the bad points of the electric, and we should not try to sell our car by knocking the other car.

Mr. A. C. Downing: On the tire question. The question of a special tire for the electric automobile is one that a good many manufacturers avoided as long as they possibly could; in fact, the first tire for that type was not developed sufficiently to give any sort of mileage, and naturally it was a source of annoyance and cost to the owner of the electric automobile. The person who purchased an electric automobile did so thinking that he was buying a simple piece of machinery free from trouble. The minute the wife or daughter or owner himself would go out on the street and have a blow-out his utterances and feelings toward the electric machine would not be fit for print, so that the tires used were all of the slow type to a greater or less extent. Some of the concerns took up the matter, appreciating the increased mileage and speed they were able to obtain and advertised a car trying to convey the idea that the advantage was in their particular car alone and due to some perfected appliance that they were able to use. That reacted on them after a while when some of the other manufacturers came out with the same equipment. But there is no question but what the tire that we have today means a great deal to the electric automobiles. For instance, say the vehicle was equipped with the standard road tire such as used on the gasoline car, making a speed of 15½ miles an hour, the draw, with two passengers and top up, being in the neighborhood of 40 amperes, that is, 60 volts, the same load under same conditions, merely changing the tires to the special electric type, would reduce that ampere draw to 33 to 34, and give a speed of 18½ to 19 miles an hour, thus making a difference of approximately 75 per cent.

The Chairman: Seventy-five per cent in mileage?

Mr. A. C. Downing: In speed and mileage. Of course, that is with a tire that will give approximately three to four thousand miles if it is properly enveloped and in operation. The manufacturers today are using them universally, and it has brought about the possibility of the larger mileage radius, more efficient working upon the part of the motor, and economical discharge rate for the battery.

Mr. A. H. Halloran: What are the particular differences between the electric tire and the gasoline?

Mr. A. C. Downing: The only difference is that the electric tire is lighter, constructed by what they call the thread construction, and it is more resilient. For comparison, take two rubber balls the same size, one of them hollow and of light rubber, and the other of solid rubber and let them drop. Your light rubber ball will come back to your hand and your heavy rubber ball will not rebound so high. It is a question of resiliency; and the life of the tire of the special electric type is necessarily shorter than the heavy car type, but we are willing to sacrifice that in order to get the other results.

Mr. G. R. Murphy: I would like to know if there are any figures published of the necessary tractive effort at different speeds with different tires and different vehicles; in other words, taking a heavy truck, could you give us at different speed the necessary tractive effort in pounds per ton in the same way that it can be obtained for interurban or street railway work? We are always compelled to resort to the manufacturer's specifications or catalogue of mileage. If we could get data like that in the form of a curve I think it would be very important, as in case of trouble it would be easy to satisfy a customer complaining of poor mileage by placing the trouble where it really exists.

The Chairman: It would be quite possible, if we always had the same road, to make tests on tires and say that the tractive effort required per ton would be a certain amount, but the difference in the character of the roads makes it very difficult to make a statement of that sort. These tests of Mr. Pfaffman show that at a speed of 15 miles an hour, the same vehicle, on same road and everything, will give a mileage of 60 with the ordinary Diamond tire; with the Motz road tire it is practically the same, with the Morgan & Wright special tire it is about 93;

and with the Palmer special tire it is 100, showing that by simply a change in tire the mileage is increased somewhere about 80 to 90 per cent. That would show that the tire problem is an extremely important one: not only does it increase the radius of action, but it increases the number of miles that the vehicle would do on one battery, that is, you can do 90 per cent more on one battery. It reduces battery renewals by nearly 90 per cent.

The Chairman: We have a gentleman with us here who has given considerable study to advertising. I will ask Mr. Pfaffman if he will give us now his ideas on advertising the pleasure vehicle.

Mr. F. W. Pfaffman: The best advertising, of course, is to put prospective purchasers into your machine and demonstrate its advantages, the speed and general road qualities of the particular machine that you want to sell. But in order to attract the attention of parties who are wholly disinterested, I have made a few experiments and am going to make some more. I have been rather successful in attracting attention to my machine. My method consists principally of getting acquainted with newspaper men and submitting to them photographs of the machine that are in an interesting attitude and also containing prominent, well-known people. I know there is very little objection on the part of people to being photographed in a machine and even to gaining their consent to have the photograph published. It does not require much urging, and the newspapers are very glad to have such illustrations for their Sunday magazines and at very small cost, that is, if you give them a very small advertising contract. That is all in proportion to one's means. Otherwise, there is the mailing of specially gotten up postal cards, to people who might possibly be interested, people of means and people you think would find considerable use for them. It is simply a matter of selecting beautiful spots and locations and having a neat photograph taken at a very small cost—postal cards made up and mailed to such men generally and regularly, say by kind of follow-up system. It is done weekly at an expense of not exceeding ten or fifteen dollars. If you have only 100 on your mailing list, it will not exceed five dollars a week. So many opportunities present themselves for interesting the public, just little everyday occurrences, if you will think them up and put them on paper. I have not so much confidence in verbal descriptions as I have in pictorial effects. Words do not seem to convey the idea so well. Furthermore, people are so abundantly supplied with literature that they cannot give them the time, but they cannot get away from a picture. Besides the other methods of advertising—we might call it advertising—is associating with people who have lots of friends and acquaintances and suggest names. I believe it is a good idea to cover the demonstration car with signs whenever you have not anybody in it that is receiving a demonstration. As far as I am concerned I ride in my car with signs from top to bottom without any embarrassment, but a prospective purchaser will not do that, especially a lady or person with means. They object to being made an object of inspection on the street. It is possible to have the signs so that you can take them off. I do not believe that kind of publicity hurts a machine, even if it is a high-priced machine, if it is used only at the proper time. Also, electric illumination signs at night at the prominent cafes and theatres, and these signs can tell a little story that might catch the fancy, glass signs nicely made up with lamps back of them in a metal case, illuminated signs illuminated by the battery which can be read for a block. I believe the proportion of expense as compared with newspaper advertising is very small, in fact, there is no comparison, and people cannot help but notice it.

Mr. C. T. Kitt: I would like to ask Mr. Pfaffman what he means by illuminated signs exhibited at the cafes?

Mr. F. W. Pfaffman: I put up four signs in my car, one under each step and one in front and one in the rear. I put them under the shafting. The signs on the front are probably 7 by 30, the rear signs 7 by 30. The metal case I attached to the bottom of the shafting. The metal case in front contains four lamps, five lamps in the rear and two lamps below the steps. When the car went down the street with all that light on it, it gave me what I think would be $50 worth in a newspaper.

DISCUSSION ON "THE ELECTRIC GARAGE."

The Chairman: Mr. Reed has been busy exhibiting in San Jose the past week, and he was rather late in getting his thoughts on paper, but his paper shows mature thought and experience. This matter is open for discussion.

Mr. R. M. Alvord: Mr. Reed mentioned the gas engine generator set for the garage. I would like to ask if he has had any definite experience in mind or can give us an account of any in that connection. I remember when I came out here about two years ago the Southern Pacific Company had just changed their signal service over from a gasoline generating plant by which they charged their batteries for the signal service to the converter system; they used a rectifier; and I have been advised that they saved considerable money thereby, in maintenance and up-keep of the batteries—considerable in labor in the first place and also in the maintenance of the apparatus.

Mr. S. P. Reed: My authority in regard to the gasoline generating plant was principally the reading of the experience of one garage, where they generated their current, and they figured the cost at 2 cents. The improvements of the gas engine I think are another matter that we have to consider; you have to become familiar with the little things that go to make it run right. It will hold its own very well with the modern methods, using a storage battery and electric devices, but of course it is not the best—no doubt of that. We simply use the gas engine generating plant where we cannot get satisfactory arrangements with the local power company.

Mr. C. T. Ryland: I have had a little experience with a gasoline engine for electric lighting purposes. When we first started up in Sonoma, about ten years ago, we had a 38-horsepower, indicated, Otto gas engine, to run an electric plant to supply the town with light. You know what a hit or miss proposition that is, with a single governor. But we succeeded in getting a steady light just the same. But the price of gasoline kept climbing and we used distillate; then the price of distillate kept climbing, and we finally used crude oil. We used the crude oil by burning the exhaust through a cylinder and got the gas out of the oil and we used the gas in the Otto engine. Our cost was less than one cent, so far as oil was concerned, but the attendance made it run up pretty high. The gross income of that plant was $150, and they made a reasonable amount of money, they did not make a fortune.

Mr. I. G. Perrin: I would like very much indeed to have an expression from somebody who has had experience with a modern generating outfit. I have had no experience myself at all, but even at the very reasonable price which we get in Oakland I think, where the garages are using in the neighborhood of $125 to $150 worth of current at 3 to 3½ cents, with a modern generating outfit they ought to be able to cut that expense down some. If there is anybody here who has had experience with a modern generating outfit, I would be glad to hear from him.

Mr. A. H. Halloran: Following the experience of the smaller operators all over the country, for instance, in lighting buildings, the isolated plant as a rule cannot compete with the central station, particularly in large cities. In figuring on the initial installation and the cost you may figure on ideal conditions while unexpected conditions will come up in connection with the operation of the plant, and it will be found more satisfactory on the whole to rely on the central station if there is a central station established. They are there for that purpose; naturally they make a profit; but furnishing current in large quantities they can give even the retail buyer a better price, and most certainly a better service than he can expect by himself.

The Chairman: The other day I wrote to all the central stations on the Coast and I have had replies as to the rates they make to garages. Those rates vary from 2 to 5 cents under different conditions. That shows that the central stations are willing to make the right rates. They are lower on the Coast than they are anywhere else in the United States. So that the question of rates that the central stations are making is a minor one. We are getting good rates, but the point we want to bring out is, that they should advertise the electric vehicle, having become convinced themselves that the electric vehicle is the proper thing.

Mr. Brand: There is an idea that came into my mind while Mr. Reed was in the early part of his paper. I would like to ask if the garage men have ever considered in connection with the individual garage of the vehicle user or owner—in the city there is a service maintained by certain individuals for caring for certain motors by monthly or perhaps weekly inspections, and they have a certain amount of customers on their routes, and it results in a very economical method of keeping the motors in condition. It occurred to me that the same thing might be applied to the automobiles. The salesmen, or company selling, for instance, could maintain these men or let individuals establish such a business for themselves, of making a weekly inspection of the garage or each of the machines. It is stated that the troubles that usually lead to disastrous results are generally minute and such as an expert could remove in their early stages very easily. I do not know whether that has ever been tried, making a route for weekly inspections.

Mr. W. D. Vance: It has been our experience when we sell a man a car who desires to take care of it himself, you must give him a promise that you will see that he has none of these troubles. In order to avoid those troubles, we have found it necessary in those cases about every two weeks to call and make a thorough inspection of the battery and motor. At the present time we are not making any charge for this, but in the future I presume that will be arranged and the owners will pay a nominal fee for that work.

The Chairman: The central stations should consider that

every electric vehicle coming into the town ad is so much motor load to their system from 12 o'clock to 6 o'clock in the morning, owing to the interposition of the battery. Another subject we promised to bring up was the tungsten lamp for lighting purposes. I will ask Mr. Reed to speak to us on that subject.

Mr. S. P. Reed: We have been working on this tungsten lamp idea for nearly two years. We imported the first tungsten lamps on the Coast from Germany, and when I saw them and saw the fine filament I thought if they had only lower voltage we would have very good lamps. Immediately after when working with the storage battery I thought we ought to have the tungsten lamp with the storage battery. I asked a number of dealers what they were doing, after the tungsten lamps were manufactured in the United States, and to see if they could get me a low voltage tungsten lamp or see if they could get them manufactured. I went to all the houses here. They promised to do what they could. Shortly after a little slip came out saying that they were going to make these lamps. Finally I succeeded in getting some from the factory and tried them out. Some of them worked very well and some of them burned out in no time. But I found that the same firm was able to furnish a very durable lamp. We used the lamp in the automobile headlight, sidelight and taillight, and we have been running them for about six months. I guess they are the oldest lamps in operation. There seems to be a great variation in the lamps. Some of them blacken a little and others will burn out, but on an average they run very well. The up-keep cost of the lamp on the whole is very small. The first ones we put on were for the side and the taillights. They were very successful. I was afraid to tackle the front lights on account of the amount of current being too large for an ordinary battery. These sidelights were so successful that I put on headlights. I went to work to find out if there was any method by which we could use them for the headlights. I had some reflectors made, the same reflector that is used on the ordinary street car for an incandescent light. They turned out very well. The difficulty that I have now is that the light is not perfectly smooth, but I found that I was more sensitive than the owner of the car. When I threw it on a current I could see that the light was irregular, and I could not overcome that; I presume on account of the shape of the filament. But when I started to put these on the cars the first was on that of a doctor in San Jose, he was very well satisfied. He came around and took me out and showed me what he could see, he said he could see a greater distance than with the acetylene light. First I had only an eight-candlepower lamp. I changed these to 12 in his car and he put in a 60 ampere battery, using it for his ignition, his headlights and taillights and sparker. Every week I told him I did not know how long his battery would run, I did not know the way he was operating his car. Every week he came in, and he ran five weeks. We generally recommend a recharge of the battery every month. He was very enthusiastic and soon brought in several others to put on these headlights. I think they are going to take very well. We demonstrated them at the San Jose show, putting out the other lights, showing that we could cast a searchlight about the room. We showed that they were clean and could be operated with ease and no risk of fire.

ENGINEERS OF WISCONSIN FORM STATE SOCIETY.

The organization of the Engineering Society of Wisconsin was completed at the first meeting, held at the University of Wisconsin February 24th, 25th and 26th, at which some 150 city engineers, general managers of power and traction companies, contracting engineers, superintendents of water and light plants, mechanical and civil engineers, and superintendents of highway construction were present and became charter members.

The officers elected were: President, Dean F. E. Turneaure, University of Wisconsin College of Engineering; Vice-President, City Engineer McClelland Dodge of Appleton; Trustees for two years, B. F. Lyons, assistant general manager of the Beloit Gas and Electric Company, and E. P. Worden, mechanical engineer of the Prescott Steamp Pump Company, Milwaukee; and Trustees for one year, E. Gonzenbach of the Sheboygan Electric Light and Power Company, and City Engineer E. R. Banks of Superior. These, as Executive Board, will elect the Secretary later.

The new organization will hold annual meetings hereafter for the purpose of bringing together the engineers from all parts of the State interested in the solution of such problems as arise in connection with municipal plants, large construction work, bridge, forest and water power questions, and light and power production. A wide range of subjects was included in the program for the initial meeting of the society.

At the opening session, February 24th, following the address of welcome by President Charles R. Van Hise, was a presentation of the scope of the highway work of the State Geological Survey, by W. O. Hotchkiss, highway engineer of the survey. A. R. Hirst, also of the State Highway Department, spoke on the use of tar, oils and emulsions on macadam and earth roads. The discussion on pavements was led by McClelland Dodge, City Engineer of Appleton, and participated in by P. H. Connolly, City Engineer of Racine, W. G. Kirchoffer, Consulting Engineer, Madison, and others. City Engineer C. V. Kerch of Janesville spoke on the construction of the Court-street bridge in that city.

Interest in the discussion of the conservation of forests and water resources of Wisconsin, a subject presented by State Forester E. M. Griffith, waxed so keen that the paper on the water power resources of the State, by Prof. L. S. Smith, who is engineer for both the State and National Geological Surveys, was postponed to the following evening. The conservation discussion was led by Senator T. W. Brazeau, and Senator E. E. Brown, Assemblyman J. R. Jones and Prof. D. W. Mead also spoke on the subject.

Prof. W. D. Pence, who is engineer for the Wisconsin Railroad Commission, opened the second day's program with a description of the organization of the Commission's engineering staff. The new problem of standard of gas and electric service was discussed by Prof. C. F. Burgess of the Department of Applied Electro Chemistry at the University, who has done important work in enabling the State Railroad Commission to prescribe a standard for fuel and illuminating gas.

The electric interurban roads of Wisconsin were made the subject of an address by F. G. Simmons, superintendent of construction and maintenance of way for the Milwaukee Electric Railway and Light Company. The day circuit for small towns was discussed by Prof. J. W. Shuster, and new forms of arc lamps by W. E. Wickenden, also of the Electrical Engineering Department. Dean Turneaure took the members of the society through the engineering experimental laboratories, explaining the work that is being done there in many lines of research.

The second night was given to a discussion of water powers, W. G. Kirchoffer describing the water supply of the city of Marshfield, and Professor D. W. Mead the subject of hydraulic and hydro-electric power development. Papers on the water-proofing of concrete, by F. M. McCullogh, City Engineer of Stoughton; municipal engineering in the Orient and in Porto Rico, by J. T. Hurd and Edwin Wray; gas producers and small power stations, by V. E. McMullen, Beloit, and C. T. Atkinson; and Madison's concrete storm sewer system, by City Engineer John F. Icke, concluded the convention program.

The electric vehicle, says the Electrical Review and Western Electrician, is essentially the proper equipment for shopping trips; for the doctor who must depend upon a machine to be in readiness day or night, and which he can manipulate himself without fuss or bother and without calling upon a professional driver. The noiselessness and ease of control of the electric vehicle make it the perfect machine for ladies' use, and for threading in and out the busy city traffic the business man for his short trips finds it an especially agreeable mode of travel.

Long-distance wireless telegraphy enabled the Nippon Yusen Taksha steamship Aki Maru to make the 4,240-mile trip from Yokohama to Seattle without being out of communication with either shore. Other vessels of the same line acted as relay stations when direct communication could not be held.

JOURNAL OF ELECTRICITY
POWER AND GAS

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The McCall's Ferry generators weigh three hundred thousand pounds, not three hundred million as stated in our issue of March 6, 1909.

The final settlement of the Kellogg case, as described elsewhere, is hailed as a great victory among Independent telephone manufacturers.

The latest census figures on the telephone show the great strength of the Independent movement in the Middle West, but do not indicate the rapid growth that the same movement is making on the Pacific Coast. Arrangements have been made whereby descriptions of some of these new installations will soon appear in these columns.

The California Legislature has passed a law requiring a telephone company to complete its plant within three years after grant of franchise; to pay an income tax of two and one-half per cent. and entailing certain restrictions on pole lines. Companies doing interstate business are exempt from this local legislation.

Civilization By Telephone

Printing is credited with having aided the advancement of civilization more than any other single factor. Books embody the ideas of one man so that many may know. The man's efficiency is thus multiplied many times. The same result is accomplished by the telephone, on a smaller scale perhaps; one not likely to displace books, but one that is constantly gaining ground.

A telephone line is almost completed across Afghanistan between the frontiers of India and Persia; the interior of what what was recently "darkest Africa" now has its telephone; and the American Indians talk to others of their tribe by its means. "Though I take the wings of the morning and fly to the furthermost parts of the sea," still can I be reached by the wireless telephone or telegraph. Geographically, non-intercommunicability will soon be a thing of the past.

The telephone has invaded the secret precincts of the harem and the underground recesses of the safe deposit vault. Its insistent ring interrupts the gravest deliberations with the most trivial message. It is found in the wilderness, mayhap that a railroad president on a hunting trip may know what is happening to his stocks. The mine secretary in a city sky-scraper may talk with the superintendent at the bottom of the mine.

In European cities the telephone service informs its subscribers of the news of the day and entertains them with opera or cafe music. Lectures and sermons are transmitted to those unable to attend the meeting. Court testimony is taken and cases tried over the telephone, and there is a record of a marriage ceremony performed in this manner. By its use the farmer is in close touch with the market and can hold his produce for favorable prices, be warned of the weather, and always be in close touch with his neighbor in case of fire, danger or sickness. Space and time are annihiliated in every walk of life as the telephone comes more and more into use.

A number of isolated individuals are closely bound by the telephone into political and social organization. With the multiplication of the means of culture and enjoyment, progress and achievement, the telephone to-day seems to be one of the most active civilizing influences at work.

PERSONALS.

S. K. Colby, treasurer of Pierson, Roeding & Co., of San Francisco, is on a short trip East.

F. W. Wachter, manager of the Empire Construction Company, left last week for Los Angeles.

John W. McDowell, represen'ing the Manhattan Electrical Supply Company, New York, spent a few days in San Francisco during the past week on his annual Pacific Coast trip for his company.

Jonathan Camp, of the Franklin Electric Manufacturing Company, Hartford, Conn., manufacturers of the Femco lamps, is in San Francisco, after spending about two weeks in Southern California.

A. T. Clark, treasurer of the American Circular Loom Company, Boston, Mass., has been spending a week in San Francisco, devoted partly to business and partly to pleasure. From San Francisco he will go to Los Angeles, and during his stay there spend a few days fishing at Catalina Island.

TRADE NOTES.

B. F. Kierluff Jr. & Co. of Los Angeles reports orders for cedar poles from the Los Angeles Gas and Elec'ric Company, the Los Angeles Aqueduct, Redlands Home Gas and Electric Company, Downey Heat, Light and Power Company, Ontario Power Company, Colton Municipal Lighting Plant, Pioche Light and Power Company, and the Pasadena Municipal Lighting Plant.

TRADE CATALOGUES.

Bulletin No. 110 from the Electric Storage Battery Company illustrates and describes the operation of chloride accumulators in connection wi h remote control oil switches. Bulletin No. 112 shows the application of the chloride accumulator to the requirements of iron and steel mills.

The Kellogg case, that of Dunbar et al. vs. the American Telephone & Telegraph Company, started nearly six years ago, has been decided in favor of the plaintiffs and ownership of the Kellogg Switchboard & Supply Company restored to Milo G. Kellogg and associates. This decision of the Supreme Court of Illinois again puts the Kellogg company in the ranks of the independent telephone manufacturers.

Bakelite is a coal-tar derivative said to possess the properties of rubber, celluloid and amber, and of use as an impregnating insulator. Its properties were described in a paper read at the March meeting of the New York section of the American Electrochemical Society by Dr. L. H. Balkeland.

Underground telephone cables have been installed between London and Birmingham, 420 miles, which, joined with that between London and Bristol and Tavistock, gives a total length of 740 miles. The maintenance cost is one-eighth that of overhead lines.

A 110,000-volt transmission line has been authorized by the Hydro-Electric Power Commission of Ontario from Niagara Falls to St. Thomas and Toronto. Three-phase, alternating current, 25 cycles will be transmitted over 293 miles of line

A telephone service meter is a counting machine that registers the number of calls to be charged against a subscriber being furnished a special kind of service. The call is registered by pressing a button.

JOVIANISM IN SOUTHERN CALIFORNIA.

The Sons of Jove in Southern California are setting a pace in organiza ion work which suggests that the San Francisco Jovians may find it necessary to look to their laurels if they are to hold the lead in Jovian work on the Pacific Coast.

The Jovians of Los Angeles have recently organized with the following committee:

Jupiter, H. V. Carter, 858; Neptune, W. R. Greene, 990; Pluto, A W. Ballard, 1304; Vulcan, A L. Havens, 1630; Mercury, William G. Stearns, 1633; Hercules, C. G. Pyle, 1308; Mars, H. Conger Bowers, 1305; Apollo, C. H Carter, 1625; Avrenim, N. W. Graham, 1629

The first Rejuvenation under authority of the new committee took place at the Hollenbeck Hotel, Los Angeles, on the night of February 27th, and was a complete success from every standpoint.

The following new members were rejuvenated and eleva'ed to the upper level:

Ralph Bissell Clapp, Calvin F. Baker, Charles H. Coulter, Oscar Ernest Thomas Jr., George Arthur Crooke, Will Carleton Caffray, Edward Warren Currier, Roland Harry Monahan, Charles Francis Hartung.

Following the rejuvena'ion the newly initiated members were entertained at a dinner, which is fully described in the following menu:

10,000 Test Menu

Cocktails
"Cyclops" Style

"B Green" Sea Turtle

Olives Celery Radishes

Reisling
"a la Vulcan"

Catalina Sand Dabs "a la Fish"
Dinkey Pickles
Potatoes Parisienne
Lamb Chops "Apollo"
Green Peas
Jovian Punch

Zinfandel
"For all Foalkes"

Roast Squab
Chicken "Stuffed a la Ballard"
Browned Sweet Potatoes
Giblet Sauce
Crab en Mayonnaise
Pyle-d" Strawberries
a la Carte
Assorted Cakes
"Graham" Wafers
Sierra Cheese
Cafe Noir

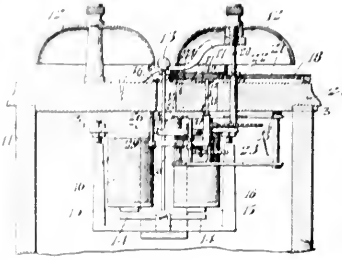
JOVIAN REJUVENATION
LOS ANGELES, CAL
FEB 27, 1909

The menu itself was unique, being printed upon a strip of armature cloth and enclosed in what was apparently a miniature dry battery cell.

All of the arrangements were carefully worked out and executed, and the success with which the rejuvenation was handled reflects great credit upon the committee.

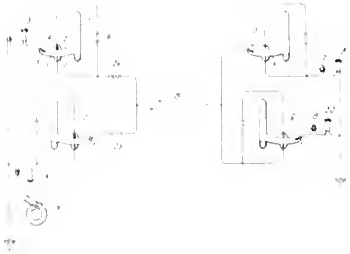
PATENTS

913,007. **Telephone Call Mechanism.** William E. Zabel, Portage, Wis. In a system of the character set forth, the combination with a signal member, of controlling means engaging with the signal member to hold the same from full operation but permitting it to be partially operated, a motor, holding means for the motor, means acting to withdraw the



holding means from engagement with the motor, and mechanism engaged with the holding means to prevent its releasing the motor, said mechanism being held in its engaged position by the signal member, but adapted to be released by a partial movement of the signal member, thus permitting the motor to actuate the controlling means and move it out of the way of the signal member.

913,521. **Multiplex Telephony.** Marius C. A. Latour, Paris, France, assignor to General Electric Company. In a system of telephony, a line conductor, means for impressing on said

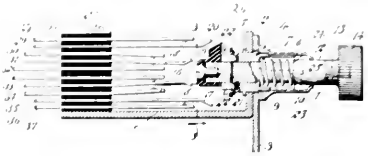


line conductor current pulsations of one polarity which succeed each other at regular intervals, means for superimposing on said current pulsations, fluctuations corresponding in frequency and magnitude to voice vibrations, means for utilizing said fluctuations to produce sound and independent means for transmitting current waves of opposite polarity to said line conductor.

912,778. **Telephone-Cord Protector.** Edward T. Banes, Philadelphia, Pa. The combination of a telephone jack plug, a flexible conductor cord attached to the jack, and a sleeve of [illegible] surrounding the cord at a point where the latter

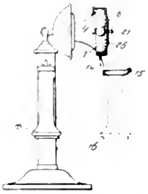
[illegible] with its internal surface in frictional contact with the cord [illegible] the tendency of the sleeve [illegible] secured to the jack to assist in retaining the sleeve in place.

913,080. **Ringing-Key.** Klas Weman, Buffalo, N. Y. In a ringing key for telephone switchboards, the combination with a longitudinally slotted tube having a lower serrated edge,



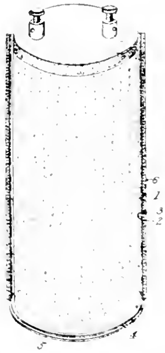
of a plunger provided with a transverse pin having projecting ends designed to travel in the slots in the tube, and a second pin carried by said plunger having rollers adapted to rest in the serrations in said tube.

912,701. **Telephone Attachment.** Arthur W. Lyda, Pittsburg, Pa., and Elmer C. Robinson, Lowellville, Ohio. A telephone attachment comprising a main member embodying an annulus or ring provided with an annular inwardly projecting



flange, a closure member hinged to the said annulus or ring, a face plate carried by said closure-member, a disinfectant pad carried by the closure member, and means common to the disinfectant pad and closure plate for securing them within the closure-member.

913,563. **Method and Apparatus for Revivifying Dry-Cell Batteries.** Horace B. Ramey, Alexandria, Va. The process of revivifying a dry battery, which consists in removing the wrapper from around the same and the sealing material from



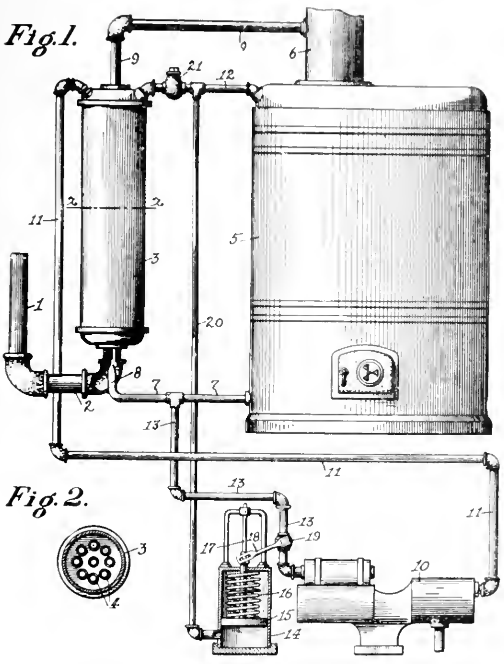
the top of the same, cleaning the external zinc surface and puncturing it with a number of holes, placing the cell thus prepared within a receptacle of imperviously coated absorbent material impregnated with an electrolyte, and pouring water into the top of the cell.

INDUSTRIAL

A NOVEL VACUUM CLEANER.

Of the many devices recently perfected for vacuum cleaning, one of the simplest and most effective is shown in the accompanying cut. Its advantages include cheapness in first cost, in operation and in maintenance, as well as excellent work, and sanitary. Dirt removal in this machine, there is nothing left after cleaning a building to dump in a sewer. The machine consumes it all and consequently is ready to move next door or anywhere and commence operations immediately.

The machine consists essentially of a flash boiler which supplies steam to an ejector so placed as to create a suction through a pipe connected with the usual form of suction



nozzle renovator. The dust is delivered through a heat interchanger where it is totally consumed before it reaches the top of the stack. This machine, which is the invention of Mr. C. Johnson, 121 Clement street, San Francisco, is in practical operation to-day.

Mounted on an automobile, it takes but ten minutes to start. It has no difficulty in maintaining a 15-inch vacuum, which is more than sufficient to effectually cleanse carpets, furniture, portieres, curtains, etc. Its simplicity makes it an ideal apparatus for installation in public or private buildings, as expert attendance is not necessary. Its low cost makes both its initial installation and maintenance much less than any other cleaner yet devised. Numerous tests have shown its economy and durability.

A patent has been applied for and a company formed to manufacture these machines. This machine when installed in a public or private building will be connected with the flue in the building, where the escaping gases will be discharged. When operated on the street, the escaping gases are discharged into the atmosphere and whatever germs, dust or other material it may gather up is totally consumed before reaching the air.

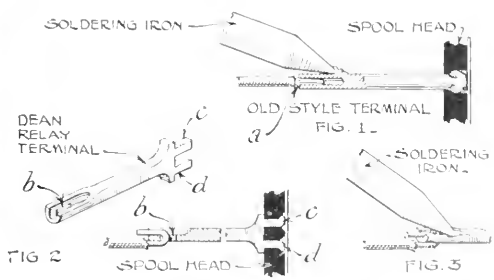
RELAY TROUBLE.

The ordinary design of relay has been the cause of considerable trouble in common battery exchange installations and much of the difficulty has been due to poor terminal facilities.

The most common terminal is similar to that shown in Fig. 1. It consists of a small brass rod with one end drilled for the insertion of the connecting wire. From the time the terminal is tinned in the factory until the outside wiring is soldered in place, this type is a continual source of trouble and expense.

In doing the tinning operation on the tubular terminal, the acid refuses to enter the opening on account of the presence of enclosed air. Thus it is impossible for the tinning solder to coat the inside. The application of a hot iron to the outside of the terminal in soldering the connecting wires expands the confined air and tends to force out the solder, so that the only portion which becomes thoroughly fastened is at "a" in Fig. 1. Unfortunately, this small amount of solder is sufficient to hold the wires in place until after the circuits are tested. Then it is liable to give away and make a loose joint, which is extremely hard to locate.

Fig. 2 shows the Dean relay terminal, which is constructed from heavy sheet brass, punched and formed into shape. The two prongs "c" and "d" are forced through per-



forations in the spool head and the inside ends turned over so as to make a secure fastening. This prevents the terminal from being pulled out, or forced through the head so as to injure the winding, something which is possible with the ordinary type of terminal.

The most valuable feature, however, is the design of the end to which the outside wiring is attached. It will be noted from the sketch that this portion of the terminal is not only perforated, but fluted. There is no difficulty in tinning this type of terminal in the factory and a thorough job of soldering the connecting wire can be done with one movement of a hot iron.

It is not necessary to hold the iron in contact a considerable time in order to make a thorough job. Thus, the complete terminal is not heated to such a point as to unsolder the connection to the winding, and loosen the terminal fastening in the spool head.

NEWS NOTES

TELEPHONE.

ANACONDA, MONT.—A new section has been added to the Anaconda company switchboard.

SHERMAN, WASH.—The line of the Sherman Telephone Company is to be overhauled this year.

KENT, WASH.—A fine building is to be put up to house the Independent Telephone Company here

GEROME, WASH.—D. M. Glasgow is president of the newly organized Southwest Telephone Company

POCATELLO, IDA.—Thaddeus S. Lane, of Butte, has been granted a telephone franchise for this city.

SALEM, ORE.—Extensive improvements are contemplated in the system of the People's Telephone Company.

DUFUR, ORE.—A 30-year franchise for a telephone system has been granted to J. A. Stevens and W. Brigham.

SAN FRANCISCO, CAL.—The Home Telephone Company is having plans drawn for the erection of two more substations.

MT. VERNON, WN.—The Farmers' Mutual Independent Telephone Company has been granted a franchise by the County Commissioners.

KNOX, WASH.—A telephone franchise has been granted to J. Arnold and associates for a local telephone which may be extended to Chehalis.

DEER LODGE, MONT.—The Intermountain Construction Company has placed orders for a complete common battery telephone plant for this place.

BERKELEY, CAL.—A 400-ply cable is to be laid along Shattuck avenue from Bancroft way to Vine street and a similar one from Bancroft way south to Derby street, by the Pacific States T. & T. Co.

MEDFORD, ORE.—The people will vote on the proposition as to whether a franchise shall be granted to the Citizens' Telephone Company, to be submitted on March 19. The franchise for the same company in Grants Pass was vetoed by the Mayor, but will be up again

SAN BERNARDINO, CAL.—The Kellogg Switchboard & Supply Company has closed a contract with the San Bernardino Valley Telephone & Telegraph Company for complete new equipments for the towns of Uplands and Ontario. The common battery multiple harmonic system will be installed, and provisions are being made for an ultimate equipment of 3,000 telephones.

ILLUMINATION.

FULLERTON, CAL.—The Anaheim and Orange Gas companies are now combined and a central plant will be located in Anaheim

PASADENA, CAL.—Bonds amounting to $150,000 have been issued by the City Council for the improvement and extension of the municipal electric lighting plant.

PETALUMA, CAL.—The City Trustees have set the rate for gas during the coming year at $1.25 per 1,000 feet and the rate for electricity at 12 cents per kilowatt. The minimum rate for gas is to be 75 cents, while that on electricity will be $1 The Pacific Gas & Electric Company has opposed the rates, stating that it cannot make a legal interest on its investment.

FINANCIAL.

CHICO, CAL.—The Pacific Gas & Electric Company's receipts for the past year were $13,590.80 for fuel gas, and $6,550.95 for electric power.

RENO, NEV.—The Reno Traction Company's report for the year ending June 30, 1908, shows the net earnings to have been $39,843.25, and the expenses $27,272.15, making the net profits $12,571.10.

INCORPORATIONS.

SAN LUIS OBISPO, CAL.—The Adelaide Rural Telephone Company has been incorporated here by Otto Wyss, A. A. Dupont, W. I. Davis and others.

BAKERSFIELD, CAL.—The Wrenn Oil Company has been incorporated here with a capital stock of $100,000 by J. B. Wrenn, E. W. King and John Robertson.

FRESNO, CAL.—The Diablo Oil Company has been incorporated here with a capital stock of $250,000 by L. W. Klein, O. F. Lundelius and W. H. Harris.

BAKERSFIELD, CAL.—The California King Oil Company has been incorporated here with a capital stock of $150,000 by H. B. Guthrey, A. G. Nichols and J. R. Riggins.

BAKERSFIELD, CAL.—The Manhattan Midway Oil Company has been incorporated here with a capital stock of $75,000 by S. E. Vermilyea, E. E. Edmunds and T. O. Turner.

SAN FRANCISCO, CAL.—The Mays Oil Company has been incorporated here with a capital stock of $500,000 by Thomas Wilkes, J. W. Mays, H. Layer, T. M. Reid and C. P. Kern.

COALINGA, CAL.—The Silver Top Oil Company has been incorporated here with a capital stock of $75,000 by W. R. Gaiberson, Z. L. Phelps, Jacob Zwang, C. R. Cutten and R. Cook.

LOS ANGELES, CAL.—The Alvarado Oil Company has been incorporated here with a capital stock of $300,000 by C. L. Bullard, J. V. and L. H. Mitchell, A. M. F. and V. C. McCullough.

RIVERSIDE, CAL.—The Church Water Company has been incorporated here with a capital stock of $36,000 by Bertha C. and A. W. Church, J. T. Jarvis, T. D. Hewitt and S. J. Castleman.

LOS ANGELES, CAL.—The Scarab Oil Company has been incorporated here with a capital stock of $100,000 by M. H. Whittier, M. J. Connell, J. M. Kellerman, W. W. Woods and R. B. Hardacre.

FRESNO, CAL.—The Madera Oil Mining Company has been incorporated here with a capital stock of $500,000 by R. Roberts, W. B. Tharman, E. M. McCardle, W. C. Maze and J. G. Roberts.

FRESNO, CAL.—The Valley Oil Company has been incorporated here with a capital stock of $3,500 by W. H. Worswick Jr., H. S. Needham, Fred Huntzicker, F. M. Pool, Jacob Richter and others.

SAN FRANCISCO, CAL.—The Kern River Drillers Oil Company has been incorporated here with a capital stock of $1,000,000 by J. Reynolds, J. M. Kent, William Sims, L. R. Young and M. A. Kenny.

VISALIA, CAL.—The Tulare Home Telephone & Telegraph Company has been incorporated here with a capital stock of $25,000 by E. W. Rice, G. C. Harris, B. W. Chenowth, Scott Hendricks and T. J. Franklin.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer — who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

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LAMP ADAPTERS

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Hubbell, Harvey.
Marshall Elec. Co.
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Perkins Elec. Switch Mfg. Co.

ALARMS

BURGLAR ALARMS

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Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc.
Western Electric Co.

FIRE ALARMS

Edwards & Co.
Western Electric Co.

WATER ALARMS

Partrick, Carter & Wilkins Co.

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ANNUNCIATORS

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Standard Elec. Wks, "C.&S."
Stanley & Patterson, Inc.
Western Electric Co.

ARMS

CROSS ARMS

Klerulff B. F., Jr. & Co.
California Pole & Piling Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

MAST ARMS

Elec. Appliance Co., "Cutter"
Ft. Wayne Electric Works.
Klerulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher"

TELEPHONE TRANSMITTER ARMS

Dean Electric Co.
Elec. Appliance Co., "Eaco."
Klerulff, B. F., Jr. & Co., "Sterling."
Sterling Elec. Co.
Western Elec. Co.

INDEX TO ADVERTISEMENTS

ASBESTOS

Johns-Manville Co., H. W.

BATTERIES

DRY BATTERIES

Dean Electric Co.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

DRY BATTERY HOLDERS

Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES

Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY

Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

STORAGE BATTERIES

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LIGHTING WITH METALLIC FILAMENT LAMPS.[1]

BY E. L. SHERWOOD.

The incandescent lamp industry, during the twenty-eight years since the lamp was invented, has had a remarkable growth. In 1880 the number of lamps made and used in the United States hardly exceeded 25,000, while in the last year there have been between fifty and sixty million lamps used in the United States alone, while the number of lamps in the world total over one hundred millions. Assuming the average price of the lamp as 15 cents for the carbon, this gives a total of over fifteen million dollars annually paid for this one detail of electric lighting service. The tale becomes more interesting when we consider that, for the entire world, including the value of the new tungsten lamps, the total annual expenditure for incandescent lamps amounts to between twenty and twenty-five million dollars, which is a most instructive illustration of the great value of the electric industry.

An idea of the large number of varieties and types of lamps on the market today may be secured from the table, Fig. 1. In the table those marked with an "x" are giving way to the tungsten.

It has been frequently pointed out that the incandescent lamp was practically a perfect invention, as in the twenty-eight or thirty years of active use the essential features of the lamp remained unchanged. It was at first, as it is now, simply a filament placed in a glass bulb from which the air had been exhausted, with conducting wires connected to the filament running through the end of the bulb to what is known as the base. To these features nothing has been added or taken away, and although numerous patents have been taken out to change the lamp, these features still remain in the present carbon lamps and also unchanged in the new metal filament lamps. In point of fact, these new metal filament lamps are practically identical with the present carbon lamps except in respect to the filament and filament mounting.

It is therefore in the filament, the light-giving portion or burner, that we must look for the radical improvement in efficieny which the new lamps secure. The conditions required in the filament are that it must be capable of standing a very high temperature and be a conductor of electricity—conditions fulfilled by a very few materials—carbon and a few metals. The earliest lamps were made with metal filaments—of platinum, which at the time was the only suitable metal practically available. The requisite temperature for the filament is, however, well above the melting point of platinum, and this metal gave way, therefore, to carbon as a very much more refractory as well as a much less expensive filament material. Carbon filaments greatly improved have since remained the standard filaments for incandescent lamps until the advent of the new tantalum and tungsten filaments.

It is of interest here to note that tungsten was available at the time the incandescent lamp was first invented, and yet could not be utilized at that time because no one knew how to make a wire or filament of it. It is very questionable, anyway, whether such a filament would have been made practical at that stage of the development, as it requires all the experience gained in the carbon lamp development to make a practical tungsten lamp today. The problem of making a filament of tungsten has been solved in somewhat of an analogous way to that evolved for making carbon filaments. The early carbon filaments were made from strips of cardboard and pieces of silk or thread, but chiefly of split bamboo, the material Edison selected as the most suitable of the natural fibres.

Then the cellulose process was evolved by which the ordinary cotton or paper was mixed and dissolved in a solution which produced a cellulose syrup or paste. In this form the material could readily be squirted through a die in a uniform thread of any desired size, which, when dried, gave an ideal fibre for carbonizing into a filament. These are then carbonized and treated and cut into the proper lengths.

Fig. 3 shows the lamp in its various stages of development. On the upper portion of the slide we see first the filament as it is cut to length, then the glass mount, the leading-in wires, and then the process of placing these three sections together in the mounted filament. In the lower row of figures we see first the lamp bulb as it comes from the lamp manufacturer. The first operation is to cut off the lower end of this, also to open a hole in the top and attach a tube of glass. This is what is known as tubulating the lamp. The mounted filament is then inserted through the lower opening and sealed in with an air-tight joint all around. The air is then exhausted and the tube melted off the top of the lamp, forming the tip. The lamp is then based, the leading-in wires cut off and soldered to the base in the proper way. After this operation the lamps are photometered, cleaned, marked and packed.

Owing to the peculiar nature of the metal tungsten, the filaments are not made by drawing a wire, but are formed by the agglomeration process; that is to say, the filaments are built up from a fine powder and by certain processes are brought into a form of homogeneous metallic filament. The filament so obtained is of a slightly gray color, and consists of hairpin loops of varying lengths, according to the size of bulb and candle power of the lamp.

The general process of mounting a tungsten filament in the bulb and completing the lamp are similar to those employed for the carbon lamp, except that much greater care in handling must be employed than is necessary with the carbon. The mounting of the filaments is an example of the greater care that is required with the tungsten filament. In the carbon lamp the filament is mounted and secured to the leading-in wires by carbon paste and the processes of doing this have been so improved that this pasting can be done by machinery. In the case of the tungsten filament the filament is welded to the connecting wires, which weld is formed by an electric arc by hand. In the four-filament lamp there are eight of these filament welds, which must be executed with great care by special hand work.

[1]Paper read before San Francisco Section, American Institute of Electrical Engineers, January 22, 1909.

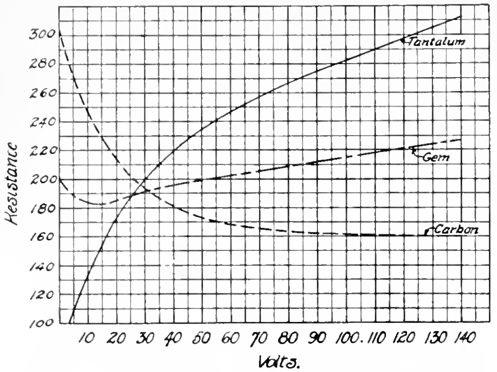

Fig. 1. Change of Resistance With Increase of Voltage.

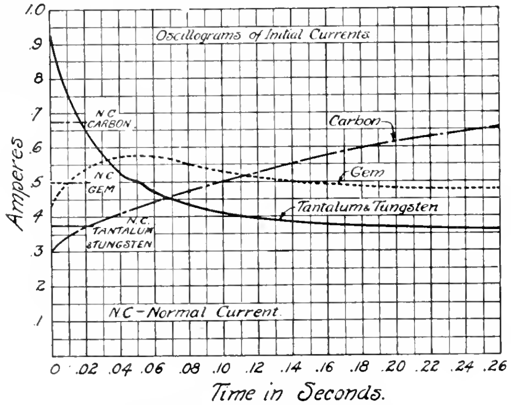

Fig. 5. Oscillograms of Initial Current.

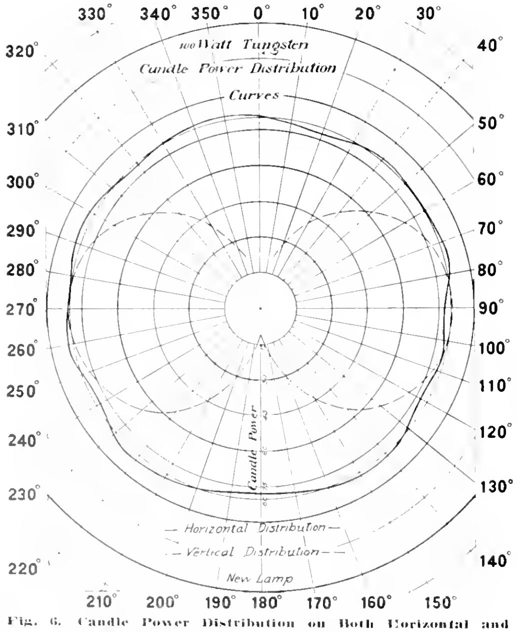

Fig. 6. Candle Power Distribution on Both Horizontal and Spherical Planes for Tungsten Lamp.

In the 100-watt tungsten lamp filament the total length of the four filament loops is 28" of a diameter of about .003". The filaments employed in the various sizes of lamps ran from .001" in diameter to about .005½" and larger. How delicate the filament of the 25-watt lamp is with its .001" diameter is hard to appreciate, but one can understand how fine this gossamer fibre is

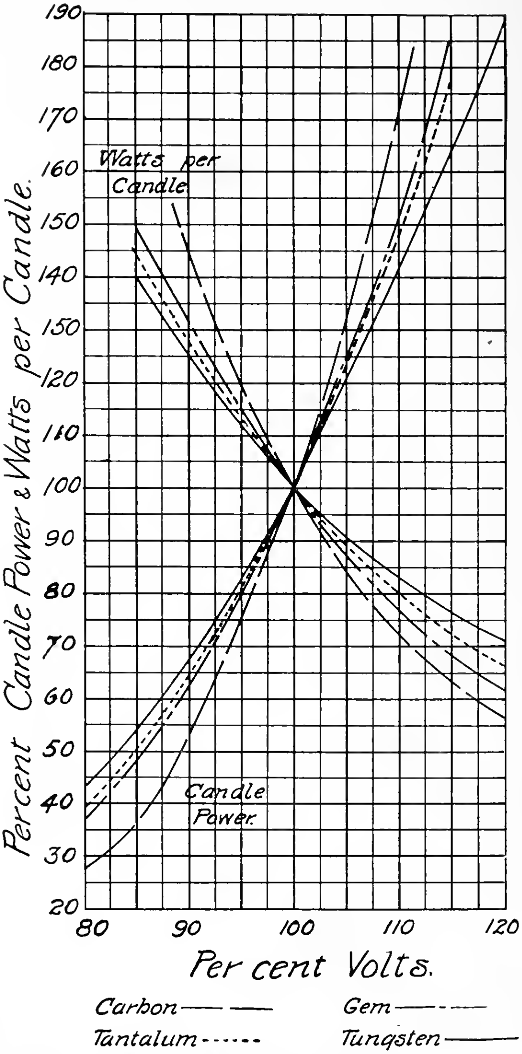

Fig. 7. Change of Watts per Candle and Candle Power Due to Change of Voltage.

when reminded that the hair of the human head has a diameter three times as great. In the manufacture of the 25-watt tungsten lamp, besides the bottom supports, to which the filament is welded with eight welds, and the four supporting anchors, there are eight middle loops, forming for each lamp twelve wire loops and anchors, which means for every thousand lamps there must be twelve thousand such loops and anchors provided.

Before passing to the commercial features in advantage of the

TABLE 1.

Changes in Candle Power and Watts Per Candle Due to Change in Voltage.

	CARBON			GEM			TANTALUM			TUNGSTEN		
	% V.	% C. P.	% W. P. C.	% V.	% C. P.	% W. P. C.	% V.	% C. P.	% W. P. C.	% V.	% C. P.	% W. P. C.
Under Voltage.	80	28		80	36		80	39		80	43	
	85	36		85	47.3		85	49.3	144.5	85	53.1	140.3
	90	52.3	145.0	90	62.0	131.8	90	64.0	128.0	90	67.0	126.0
	92.5	62.6	132.0	92.5	70.2	123.7	92.5	72.0	120.5	92.5	75.0	118.9
	95	76.0	120.0	95	79.6	115.5	95.0	80.7	113.4	95	82.9	112.0
	97.5	87.1	109.6	97.5	89.1	107.5	97.5	89.7	107.0	97.5	91.2	106.5
	100	100	100	100	100	100	100	100	100	100	100	100
Over Voltage.	102.5	115	91.8	102.5	112	93.5	102.5	111.3	94.0	102.5	110	95.4
	105	130.5	84.3	105	124.1	87.5	105	122.8	89.2	105	120	91.7
	107.5	149.0	77.2	107.5	138	82.3	107.5	135	84.6	107.5	130.4	86.8
	110	169.2	71.5	110	152.7	77.3	110	148	80.1	110	141.6	82.9
	115		63.0	115	185.5	68.2	115	177.7	74.3	115	164	76.2
	120		56.4	120		61.6	120		66.0	120	188	71.0

tungsten lamps, it would be of interest to consider some of its technical characteristics, which we can perhaps better understand when we contrast them with the same characteristics of the well-known carbon lamps.

First it will be interesting to compare with the relative lengths and diameters and surface of filaments of the various lamps:

Filament.	Length Inches.	Diameter	Projected Areas Square Inches.	C. P. Per Sq. Inch of Projected Area
Carbon 25 c. p..........	9.4	.0060	.0564	443
Metallized 20 c. p.......	9.5	.0037	.03515	570
Tantalum 20 c. p.......	23.4	.0018	.04212	474
Tungsten 100 w., 80 c. p.	28.	.0029	.0812	98.5

The resistance characteristics of metal filament lamps such as tungsten are the reverse of those of carbon, and Fig. 4 illustrates the law of change of resistance with increasing temperature or voltage for the different types of filament. As a result of this resistance characteristic, there is a very interesting difference in current flow of the different lamps when the current is turned on. This is shown in the oscillograms of the initial currents of the different lamps as illustrated in Fig. 5, as given by Prof. Amrine of the University of Illinois.

The candle power distribution on both horizontal and spherical planes is shown for the tungsten lamp in Fig. 6 The ratio of mean horizontal candle power to mean spherical candle power, or what is known as the spherical reduction factor, is approximately in the new lamps as follows: Carbon, .810, metalized, .803; tantalum, .787; tungsten, .79.

This factor does not vary very much for the carbon, metalized or tungsten lamp during life, but changes in the tantalum, giving a higher ratio at the end of life than at the beginning, due to the change in the structure of the filament.

The relative life and candle power performance, that is, the change in candle power during life, and also the change in total watts and watts per candle power, are given in Fig. 7. for the different lamps. This shows remarkably long life for the tungsten lamp, with its high efficiency well beyond that obtained for the carbon, except at the lower efficiencies.

The relative variations in watts per candle and candle power with change in voltage for the different lamps are given in Fig. 8 and Table No. 1.

The efficiency of the lamp as a producer of light in common with other forms of lamps is very low. The carbon incandescent lamp has a better efficiency than any other commercial form of lamp, except the arc light, and for the ordinary carbon lamp the light-giving efficiency runs about 3½ per cent., that is, 96½ per cent., of the energy consumed by the lamp is wasted in heat and non-luminous vibrations, and only 3½ per cent. given out in luminous vibrations.

This has been increased by the new tungsten lamps to about 8 per cent., which is quite a material gain, considering the importance of the efficiency of the lamp, which is placed, so to speak, at the peak of a pyramid to receive the very small portion of energy which remains from the coal after the losses in boiler, engine, dynamo, transmitting line, etc., have been subtracted.

It will be of interest here, perhaps, to consider how the efficiency of light production is increased with the new tungsten filament lamps. The diagram Fig. 10 gives the energy in the various regions of the spectrum for the various temperatures. The white space shows the luminous portion of the spectrum and the shaded portion the non-luminous vibrations. It will be seen that as the temperature is increased a larger proportion of the energy, as shown by the different curves, is thrown into the luminous part of the spectrum; therefore the higher the temperature the greater is the proportion of luminous to non-luminous vibrations.

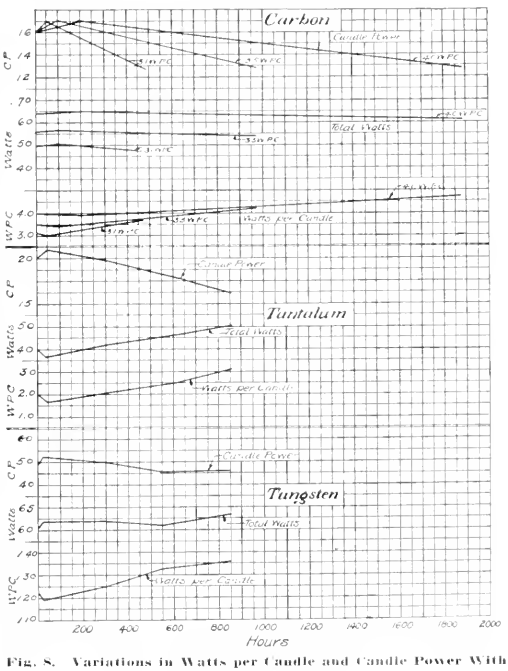

Fig. 8. Variations in Watts per Candle and Candle Power With Change of Voltage.

Some of the gains in efficiency also result from a selective radiation of tantalum and tungsten; that is, such metals give a higher ratio of luminous to non-luminous radiations at the same temperature than is given by the ordinary carbon filament.

The marked gain in efficiency which results from increase in temperature is indicated by the fact that, at the working temperature of these metal filament lamps, the intensity of light emitted varies about as the twelfth power of the temperature, while the electric power supplied to the filament varies about as the fifth power of the temperature.

The tungsten lamp has now been on the market for a little over a year and over six million American-made tungsten lamps

have been sold and placed in service. It is a remarkable manufacturing record which the past year has given in the matter

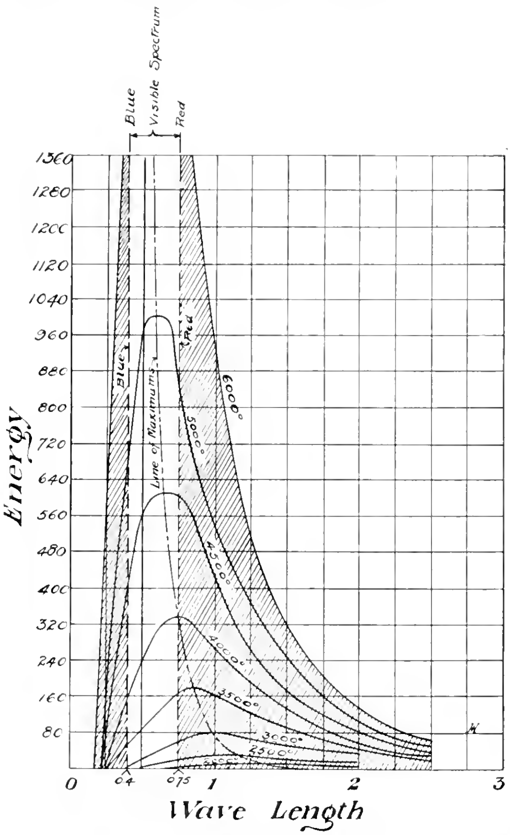

Fig. 10. Energy in Various Regions of Spectrum for Various Temperatures.

of development of the tungsten lamps, when we consider how many years it took to develop the carbon filament lamp and then consider that in practically one year the present tungsten lamps have been developed with their excellent life performance and service results, and the many innumerable difficulties attendant on a new development that have had to be overcome so as to make the lamp, with its very fragile and delicate filament, commercially practicable, not only in the laboratory, but as a regular product to be shipped and handled. With all, this production has been brought up to the point where over 40,000 finished lamps per day are being produced.

Table 2 is a comparison showing minimum costs to the largest purchasers with the relative values of the different lamps as shown.

In Fig. 11 we have an illustration of diagram showing costs of producing 100 candle hours of light for the different lamps, which graphically indicates where each lamp qualifies as the most economical producer of light, considering the cost of power and cost of renewals.

In Fig. 12 we have graphically shown the saving secured by the 100-watt tungsten, and the rate at which it pays its first cost.

TABLE 3.

Tungsten vs. Carbon Lamps.

Hours of Life to Save Full Cost of Tungsten Lamp at 10c per K. W. Hour.

	20 c. p.	32 c. p.	48 c. p.	80 c. p.	200 c. p.
Carbon lamps consume in watts	62	100	150	250	620
Tungsten lamps consume in watts	25	40	60	100	250
Watts saved by Tungsten	37	60	90	150	370
Value of saving per hour at 10 cents per k. w. hour	$0.0037	0.006	0.009	0.015	0.037
List price of Tungsten lamp	0.85	1.10	1.40	1.75	3.50
Hours life to repay cost of Tungsten	230	183	155	116	94.6

It will be noted that for 800 hours life assumed for the Tungsten, the following is true:

25 watt Tungsten saves its first cost 3 times over.
40 watt Tungsten saves its first cost 4.4 times over.
60 watt Tungsten saves its first cost 5 times over.
100 watt Tungsten saves its first cost 7 times over.
250 watt Tungsten saves its first cost 8 times over.

In Table 3 is shown the hours' life required to save the full list cost of the tungsten as compared to equal candle power of carbon lamps at the 10-cent rate per k. w. hour.

TABLE 4.

Central Station Lamp Charge which Customer could pay without loss, for the various types of lamps, assuming in each case that he can obtain the carbon lamps on free renewal.

TYPE OF LAMP	Assumed rate per kw. hour.	Assuming that one new type lamp replaces each 16 c. p. carbon lamp.	Assuming that one new type lamp replaces each 32 c. p. carbon lamp.	Assuming that enough new types lamps are used to furnish as 16 c. p. service as 16 c. p. carbon lamps
20 c. p.	5c	$1.25		$1.85
	7½c	1.875		2.775
25 watt	10c	2.50		3.70
Tungsten	15c	3.75		5.55
32 c. p.	5c	.50	$3.00	$3.00
40 watt	7½c	.75	4.50	4.50
Tungsten	10c	1.00	6.00	6.00
	15c	1.50	9.00	9.00
48 c. p.	5c		$2.00	$1.50
60 watt	7½		3.00	7.00
Tungsten	10c		4.00	9.00
	15c		6.00	13.50
80 c. p.	5c			7.50
100 watt	7½c			11.25
Tungsten	10c			15.50
	15c			22.50

In Table 4 we show the price which the customer could afford to pay for the various tungsten lamps with the carbon lamps furnished free. These results are also shown in Fig. 13.

TABLE 2.

Comparison of Carbon, Tantalum and Tungsten Lamps and Service at Minimum General Prices.

	CARBON	TANTALUM		TUNGSTEN			
	50 W 16 c. p.	40 W	25 W	40 W.	60 W.	100 W	250 W
Assumed life	500	800	800	800	800	800	800
List Price -20%, 15% and 10%, Dis.	.136	.34	.52	673	.8568	1.071	2.142
k. w. hours during life	....	32	20	32	48	80	200
Cost of renewals per k. w. hour	.55c	1.06c	2.6c	2.1c	1.79c	1.34c	1.07c
Candle hours during life	7350	14,720	15,000	23,680	35,580	60,000	150,000
Cost of power per 100 candle hours @ 10c per k. w. hour	3.4c	2.17c	1.33c	1.33c	1.33c	1.33c	1.33c
Cost of renewals per 100 c. p. hours	.185c	.231c	.347c	.204c	.241c	.179c	.143c
Total cost of power and lamp renewals per 100 c. p. hours	3.585c	2.401c	1.677c	1.614c	1.571c	1.509c	1.473c
Cost of power per 100 hours of service @ 10c per k. w. hour	50c	40c	25c	40c	60c	$1.00	$2.50
Total cost of power and lamp renewals per 100 hours of service	52.72c	14.25c	31.50c	48.42c	70.71c	$1.134	$2.768

TABLE 5.

Minimum Rate for Current at which the Customer can begin to afford to buy the several types of lamps at the price indicated. Assuming that he now gets free renewal of the Standard 16 c. p. Carbon Lamps.

TYPE OF LAMP.	Assumed central station charge for lamp.	kw. hour rate at which lamp pays for itself if it replaces a 16 c.p. carbon lamp.	kw. hour rate at which lamp pays for itself if it replaces a 32 c.p. carbon lamp.	kw. hour rate at which lamp pays for itself if it replaces enough 16 c. p. carbon lamps to furnish equal candle power.
20 c. p. 25-watt Tungsten.	$ .85	3.4c		2.30c
	.60	2.4		1.6
32 c. p. 40-watt Tungsten.	.75	7.5c	1.25c	1.25c
	1.10	11.00	1.83	1.83
48 c. p. 60-watt Tungsten.	.90		2.25c	1.0c
	1.40		3.5	1.55
80 c. p. 100-watt Tungsten.	1.10			0.733c
	1.75			1.16
200 c. p. 250-watt Tungsten.	2.25			0.565
	3.50			0.875

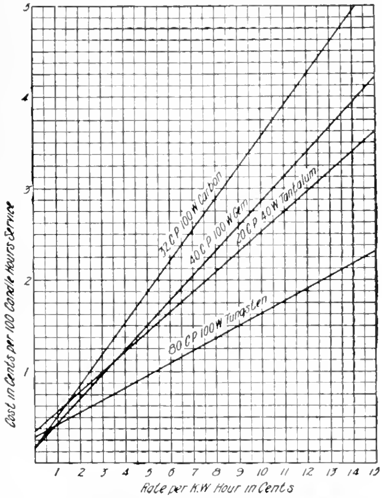

Fig. 11. Total Costs to Consumers of 100 Candle Hours of Light With Different Lamps.

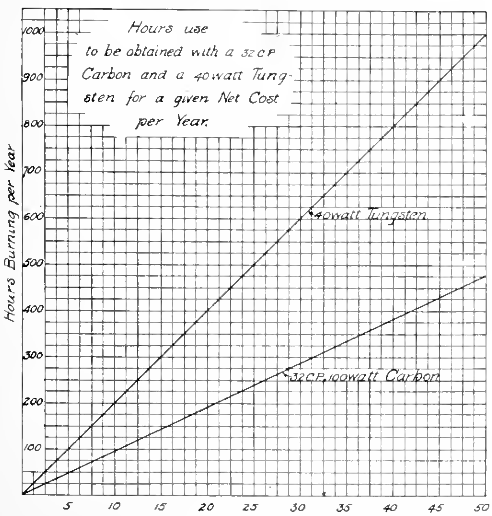

Fig. 14.

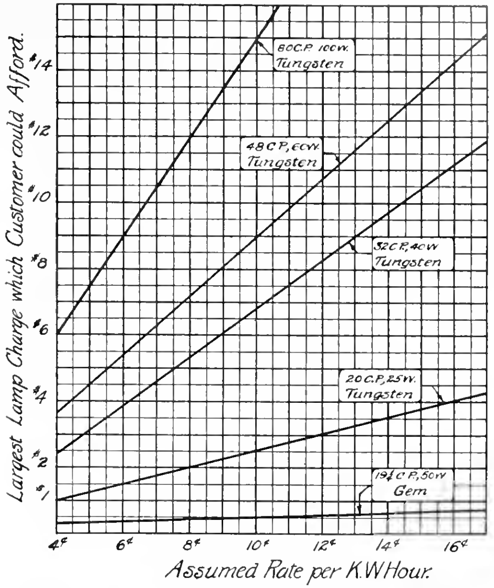

Fig. 13. Price at Which Customer Can Afford to Pay for the Various Tungsten Lamps With the Carbon Lamps Furnished Free.

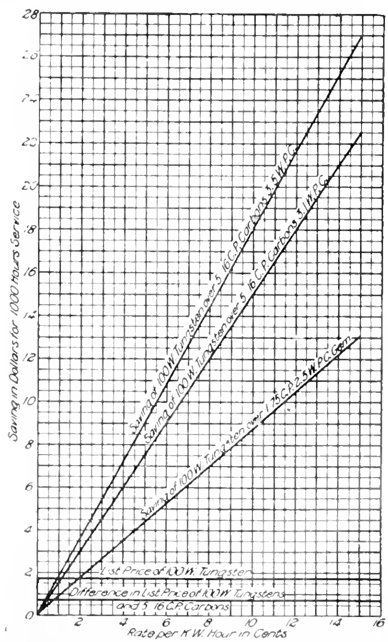

Fig. 12. Saving in Current Cost for Equal Illumination With 100 Watt Tungsten Over Other Lamps at Various Rates per k. w.

In Fig. 14 is shown a diagram of the number of hours' use obtainable for a given annual cost for the 32 c. p. carbon and the 32 c. p. tungsten.

Table 5 shows the minimum rate per k. w. hour for current at which the various lamps pay their full cost.

Fig. 1. Standard Types Large Incandescent Lamps for Multiple Service.

	Volts.	CARBON. 3.1-4 w. p. c. C. P.	Watts.	Bulb.	GEM. 2.5 w. p. c. C. P.	Watts.	Bulb.	TANTALUM. 2.0 w. p. c. C. P.	Watts.	Bulb.	TUNGSTEN. 1.25 w. p. c. C. P.	Watts.	Bulb.
Regular 95-250 Volts.	95-130 Volts.	2	4.8-6	SS14									
		4	4.8	SS17									
		6	3.7-4.3	SS17									
		8	3.1-4	SS17									
		10	3.1-4	SS17									
		12½	3.6-4	SS17									
		16	3.1-4	SS19									
		16	3.5-4	PS21	16	40	SS19	12½	25	SS19	20	25	SS19
		20	3.0-3.5	SS19	20	50	SS19	20	40	M19	32	40	SS21
		24	3.1	SS19	32	80	SS24	25	50	M19	32	40	ST21
		20	4	SS21	40	100	B25	40	80	ST24½	48	60	ST24½
		25	3.6-4	SS24	50	125	SS30				80	100	SS30
		32	3.1-3.6		75	187	SS35				200	250	ST40
					100	250	SS40						
	200-250 Volts.	5	6	BTH19									
		8	4.4	BTH19									
		16	3.4-3.8	PS21									
		20	3.8	PS21									
		24	3.8	PS21				25	50	ST21			
		32	3.8	SS24				40	80	SS30			
		50	3.8	SS25				80	160	SS30			
		100	3.8	SS35									
Irregular 95-130 Volts.	Round.	4	4.8	G18½									
		8	4.1	G18½									
		10	3.6	G18½									
		16	3.5-4	G18½				Round Bulb.					
		16	3.5-4	G25				12½	25	G18½			
		32	3.6	G30									
		50	3.6	G30									
	Tubular.	8	4.1	T10-36									
		10	3.6-4.2	T10-36	Meridian Type.			Meridian Type.			Meridian Type.		
		16	3.1-3.5	T10-36	25	50	G30	25	40	G30	40	40	G30
		32	3.6	T14-38	50	100	G40	50	80	G40	60	60	G40
	Stereopticon.	20	3.8	G20									
		32	4.0	G20									
		32	4.0	G25									
		50	4.0	G25									
		100	3.75	G30									
	Reflector.	Total Watts.											
		14 4		SSR18-16									
		35		R24-19½									
		45		R28-23									
Irregular 200-250 Volts.	Round.	8	4.4	G18½									
		16	3.8	G18½									
		16	3.8	G25									
		32	3.8	G25									
	Tubular.	16	3.8	T10-36									
	Stereopticon.	32	3.8	G25									
		50	4	G25									
		100	3.75	G30									
	Reflector.	Total Watts.											
		35		R24-19½									
		45		R28-23									
	Meridian.	60		G30									
		120		G40									

NOTE. The large number of types shown in above table is further multiplied by different bases and colors. In addition to these standard multiple lamps the variety of street series types (with carbon, Gem and Tungsten filaments), and Miniature-decorative, candelabra, battery, surgical, novelty and special lamps (with carbon, Tantalum and Tungsten filaments) present an even more formidable array.

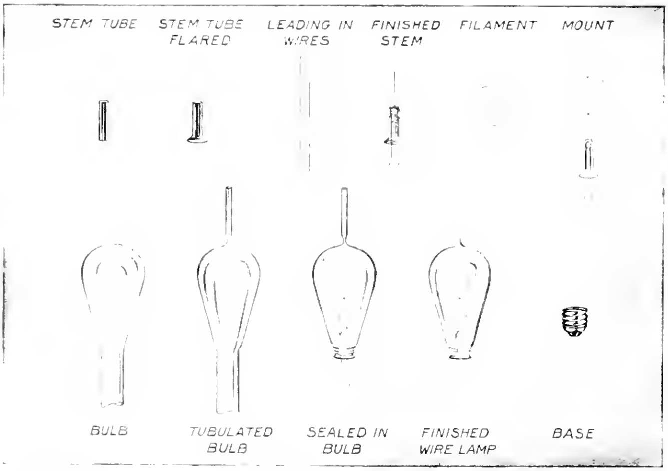

Fig. 3. Various Stages in Development of Incandescent Lamp.

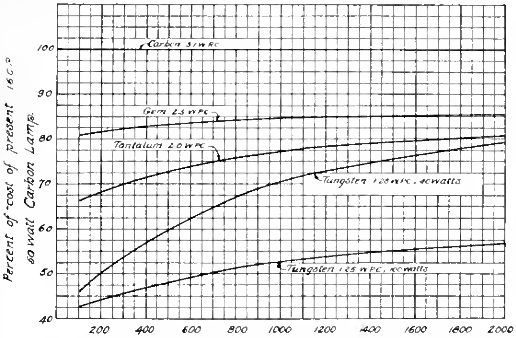

Fig. 15. Relative Cost of Producing a Candle Hour of Light With Carbon 3:1 w. p. c., 16 c. p. light, as 100 per cent.

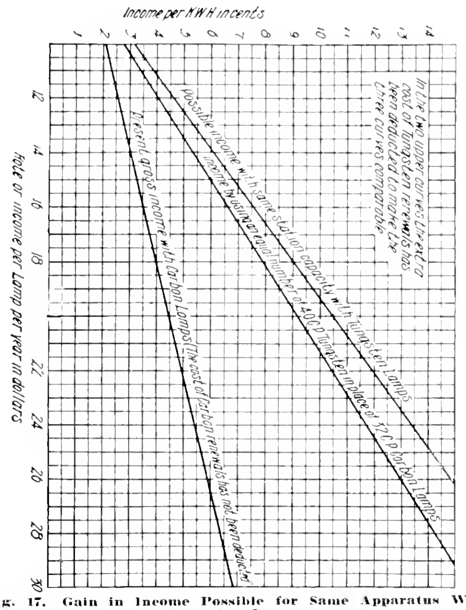

Fig. 17. Gain in Income Possible for Same Apparatus With Tungsten Lamps.

In Fig. 15 is shown the relative cost of producing a candle hour of light with various lamps on the differential cost basis.

In Fig. 17 is shown, for series lamps, the gain in income which is possible for the same apparatus with the tungsten lamps as compared with the carbon lamps.

The 25-watt lamp has been in the field only a couple of months, and its sales already amount to nearly as much as those of the 40 and 60 watt types and will, before long, materially exceed that of any other size. The 40-watt lamp is also provided in the small standard bulb so that it will fit into the regular installations without changing any fixtures or shades, and this lamp should prove equally popular to the 25-watt size, giving, as it does, twice the candle power of the ordinary 16 c. p carbon lamp, with 25 per cent. less energy consumption

We have, from time to time, received very interesting reports on the life and candle power performance of the tungsten lamp, and know from these records that the life of the commercial lamp of today is remarkably long. The lamp can safely be counted upon for giving a life of approximately 800 to 1,000 hours, with candle power so well maintained that the decrease in brilliancy is not noticeable.

GERMAN MUNICIPAL ELECTRIC PLANTS.

Consul Thomas H. Norton of Chemnitz furnishes the following review of the operations of municipally owned electric plants in Germany, and the main factors entering into their conduct:

Germany is making experiments in so many directions in connection with the municipalization of public utilities that the results of her experience are becoming more and more valuable for other countries. Of especial interest at present is the outcome of the widespread management by cities of generating plants for electricity, supplying current for both power and illumination.

The following table shows the net annual profit or loss of such plants in 32 cities owning and managing the entire equipment. All of these cities have populations in excess of 50,000. The figures given are for 1905, and represent the surplus, or deficit, remaining after payment of interest and deduction of the customary amounts for sinking funds and depreciation.

City—	Annual surplus
Aachen	$54,000
Altona	90,000
Barmen	21,420
Bochum	46,000
Bremen	92,000
Breslau	78,000
Kassel	31,000
Chemnitz	32,000
Koln	82,000
Krefeld	22,000
Darmstadt	13,000
Dresden	77,000
Dusseldorf	91,000
Elberfeld	10,000
Erfurt	2,000
Frankfort	330,800
Freiburg	5,000
Gelsenkirchen	3,000
Hanover	20,000
Kiel	20,000
Muhlhausen	17,000
Munchen	47,000
Nurnberg	58,000
Potsdam	11,000
Stuttgart	89,000
Wiesbaden	17,000

City—	Annual deficit
Dortmund	$62,000
Gorlitz	238
Halle	21,420
Konigsberg	5,000
Plauen	238
Posen	4,522

It is noticeable that in but few cases are surpluses of any considerable amount entered upon the balance sheets. Even in such cases experts express doubts as to whether the sinking and depreciation funds are fully adequate from a business standpoint.

Electric power for the Alaska-Yukon-Pacific Exposition, which opens in Seattle on June 1st, will be furnished from Snoqualmie Falls, 10,000 k. w. at 13,200 volts, delivered to the substation at the fair grounds, which will also care for overloads at the terminals of the street railway system. There will be 250,000 incandescent lamps used on the grounds, including a special equipment of tungsten lamps for the Fine Arts Building. A great waterfall will be illuminated by electric searchlights; electrical exhibits, including wireless communication, electric vehicles and motor boats, will be installed in the various buildings, and every endeavor made to show the most advanced stages of the art.

INTERFERENCE WITH ELECTRIC WIRES IN MOVING BUILDINGS.

BY EMERSON W. READ.
Member of the San Francisco Bar.

Some interesting decisions have arisen on the subject of moving houses along public streets. It can be readily seen that such an employment will interfere with numerous industries and practices, especially on the more prominent thoroughfares.

Seemingly, Courts have not taken a favorable view of this practice. Ingenious arguments have been found by judges against such a use of the public streets. It has been judicially said that moving houses along a public highway is not an ordinary use of the highways and is not within the rights to be enjoyed by the public in such highways. One Court saw dangerous possibilities in severing wires to allow a towering building to pass; travel will be interrupted and passengers will suffer an inconvenience not to be tolerated for such a reason. In few present-day city streets can a building worthy the name be moved any distance without necessitating a cutting of telephone, telegraph, or trolley wires.

Ordinances usually fix the elevation of wires to be strung in streets. Telegraph and telephone wires may easily be regulated. It matters little whether telephone and telegraph wires are strung at an elevation of forty, fifty, or sixty feet, but the case of trolley wires is very different. Their effectiveness depends on an elevation itself to be determined by the elevation of a car. The elevation of trolley wires cannot be so easily regulated by ordinance. When a franchise is granted the presumption follows that the trolley wires to be strung will be at an elevation which will interfere with building-moving on the streets. That the moving of buildings along streets conflicts with the usual uses of such streets (a thoroughfare for trolley wires, for example) will alone show that such a practice is no "ordinary use" of streets

In the Fort Madison Street Railway Company case it is said, "There is no doubt but that one desiring to change the location of a house or other structure may move it along a public street, providing the conditions of the street are such that this may be done without injury to others having a prior right thereto; and provided, further, that this does not, by interfering with travel, become a nuisance." The ultimate holding in that case has been elsewhere expressed in these words: "Inasmuch as the street railway company had a franchise to run its cars in the street, and as the owner of the house could not move it as intended without occupying the company's track, destroying the trolley line, and interrupting for a considerable time the operation of its cars, it was held that he was not entitled to take the house into that street."

The rule in Ohio, as shown in Toledo, B. G. & S. Traction Company, Sterling (20 Ohio C. C. 227) seems to comprehend a right in the public to move buildings in public streets, and even in streets that are the thoroughfares of electric wires. In that case it was determined, "It would be a reasonable requirement on the part of an electric street railway company that houses should be moved across its tracks only in the night time, both for the protection of the public from any danger which might be involved in the removal or disconnection of the wires at a time when the current was on, and also to avoid injury to the company by the interruption of its travel, and the inconvenience of passengers in their transportation, and the right of the people to travel along the company's tracks in its cars."

It would be useless to name the States which have specifically held that "moving houses along a public highway is not an ordinary use of a street, and is not within the right which is enjoyable by the public in such highway." It is interesting, however, that Illinois, New Jersey and North Dakota have so determined.

The North Dakota case (Northwestern Tel. Exc. Co. vs Anderson, 12 N. Dak. 585), now quite famous and of wide acquaintance to law writers, arose in an action brought by a telephone company to recover damages alleged to have been caused to the company's property by the defendant while moving a house through and upon the streets of the city of Grant Forks. "Was the right granted a naked permission to set poles and string wires on the streets, or was it accompanied by protection from damages by reason of other usages of the street permitted by the council for private purposes? The appellant in this case is not asking to be allowed to make an ordinary use of the streets of the city. He is, on the contrary, asking that he be permitted to use the streets in an extraordinary mode, and for an unusual purpose. It would be strange, indeed, if large buildings could be moved along the thronged streets of a city without control or restriction, and it would be equally strange if the owner of a building could destroy the property of others to enable him to move his building from one place to another. To compel plaintiff to remove its wires or repair them whenever called upon to do so by persons moving houses would add a burdensome and unreasonable condition to the ordinance under which it acts."

In Indiana the injunction was used (in Williams vs. Citizens Railway Company, 130 Ind. 71) to restrain a house-mover from cutting wires. The city ordinance required all wires to be twenty-two feet above the level of the street. The wires in question hung fourteen feet above the level of the street. The building could have passed under wires elevated twenty-two feet. The injunction was granted, regardless of these figures, on the right of the public to regular and continuous running of the street cars.

The Ordinances of San Francisco (1904) provide for moving of houses in the streets of that city. Among other provisions of the Ordinance it is required "Whenever the owner of any building intended for human occupation shall desire to remove the same along any public street he must make a written application to the Board of Public Works for permission so to do." The part of Ordinance No. 1026 applying to wiring in the streets only applies to wires belonging to the city's Department of Electricity. "Also a further sum not exceeding twenty-five dollars in coin is deposited with the Chief of the Department of Electricity to defray all expenses of said Chief of the Department of Electricity in taking charge of, removing, fixing and repairing the wires or system or any portion thereof, or any damage thereto, connected with said Department of Electricity, in consequence of the moving or removal of any house or building."

EXAMINATION FOR MECHANICAL DRAFTSMAN.

The United States Civil Service Commission announces examinations on April 14-15, 1909, to secure eligibles from which to make certification to fill vacancies as they may occur in the positions of mechanical draftsman and topographic draftsman in the Isthmian Canal Service. The entrance salaries of these positions are as follows: Mechanical draftsman, first class, $150 a month; second class, $125 a month; topographic draftsman, $125 a month; tracer, $100 a month.

YREKA, CAL.—President Jesse W. Churchill and Secretary Alex. J. Rosborough, representing the Siskiyou Electric Power & Light Company, have filed claims to 450,000 inches, measured under a four-inch pressure, of the water of the Klamath river, to be taken out at two points about half a mile distant from the present power plant on Fall creek. This spring the company will begin work on a new power plant on the Klamath river, near Ward's canyon, which is capable of developing 60,000 horsepower. The present plant at Fall creek is now developing 6,000 horsepower, which is insufficient for the present demands.

Telephone train dispatching on the Canadian Pacific Railway has been so successful between Montreal and Farnham that it has been decided to adopt it on two circuits on the western lines of the road. Ultimately it will replace the telegraph in the operation of trains.

CURRENT COMMENT

Aluminum foil is replacing lead and tin for many packing purposes, as it is non-poisonous and cheaper than tin.

A street railway strike in Manila on March 4 was promptly squelched by employing non-union Filipinos and Americans, who ran the cars under police protection.

French letter-telegrams in the first month of use totaled over seven thousand and contained nearly four hundred thousand words. These are sent at reduced rates during certain hours.

Carbon bisulphide is produced in a specially constructed electric furnace which allows a continuous run of over a year. It is a powerful solvent for gutta-percha and other organic compounds.

Cement for lining boiler furnaces with sheet asbestos may be made from fire clay mixed with silicate of soda. China clay used in the same way makes a neat job if the heat is not excessive.

Ohio independent telephone stations totaled 324,663, as compared with 307,674 in 1907, according to statistics compiled by President F. L. Beam, of the Ohio Independent Telephone Association.

Photo-telegraphy received its first practical test in the United States when the photographs of President Taft and Mr. Roosevelt were sent over the wires from Washington to New York on March 4th by the Korn apparatus, American rights for which are controlled by Collier's Weekly.

Electric power from peat-gas machines is to be furnished the region around Svedala, Sweden. A ton of peat will produce over three thousand cubic yards of gas. Peat-gas machines are said to require less than half as much fuel as steam machines for the production of a given amount of power.

German electro-chemical industries are reported to be suffering from over-production and market depression. Competition has reduced the price of aluminum to about the cost of production; the calcium carbide market is unfavorable and the iron-alloys not in demand because of the lessened steel output.

A strike of telegraph operators has interfered with the communication rendered by the Paris Bureau of the Postoffice. General dissatisfaction with the government plan of promotion by the partial merit system instead of by seniority not only caused this strike but may also bring on a strike of the telephone operators.

Power plants for the locks at Gatun and Miraflores on the Panama Canal are being installed first to operate the concrete mixing and handling apparatus, and later as a reserve to operate the locks should hydraulic power fail. Six 1500 k. w. Curtis steam turbines, together with generators, boilers, oil pumps and auxiliaries are on the ground.

Steel bands as belts for power transmission can be substituted for leather or rubber, particularly with small diameter pulleys. They do not stretch nor slip, have but little wear, and run noiselessly. Tests made by Professor Kammerer, of Charlottenburg, show that ten horsepower can be transmitted by a steel band one centimeter wide and one-half millimeter thick.

Soldering aluminum has always been difficult, and contact is usually obtained by riveting or by the MacIntyre joint for wires. A formula patented by two Belgians, J. I. and Rene Wilbrin, is said to be good if the aluminum parts to be soldered are perfectly clean. It consists of a mixture of 90.6 parts of tin, 68 of zinc and 9 of copper.

Poles for telephone and telegraph use in 1907 amounted to 2,311,651, costing an average of $1.72 apiece. This represents two-thirds of the entire pole production of the country. Cedar poles constituted over two-thirds of this and chestnut nearly one-fifth. The ravages of decay are shown by the large proportion used for renewals—fully two-thirds.

A liquid microphone is used by Prof. W. Majorana in his new system of wireless telephony. A stream of acidulated water flows between a pair of platinum electrodes placed in a small tub attached to the diaphragm of the microphone. This stream fluctuates as the microphone is vibrated by the voice and thus varies the electrical resistance in accordance with the sound of the voice.

Spontaneous ignition of engine waste as experimentally investigated by Mr. Nowicki is described in a recent issue of "Gluckauf." The rise in temperature, measured as air was drawn through the greasy mixture by an aspirator was found to be about 180° C. in 2½ hours, sufficient to char the waste. It is advised that all cotton waste be burned as soon as it has absorbed its own weight of oil.

An electric anemometer has been invented by Prof. R. B. Goldschmidt of the University of Brussels. It depends upon the variation in resistance of platinum with temperature change. One wire is exposed to the wind, the other shielded, these wires forming two branches of a Wheatstone bridge. If a current of air strikes the exposed air there will be a difference of temperature which is recorded by a galvanometer.

A forest products' laboratory is to be established at the University of Wisconsin, at Madison, by the United States Forest Service. The establishment of the laboratory means the concentration of all lines of the experimental investigations of the government looking to closer and better utilization of timber and the checking of wood waste. Forest Service laboratories for timber test work at Yale and Purdue Universities and the government's wood pulp and wood chemistry laboratory in Washington will be consolidated and transferred to Madison as soon as practicable. A force of 15 to 20 timber test engineers, experts in wood preservation, wood pulp manufacture and wood distillation will have charge of the work carried on. The laboratory will have an equipment valued at not less than $15,000.

Japanese electric railways have a total length of 165 miles with 100 miles more under construction, according to Consul John H. Snodgrass. This has been done by 16 companies with an aggregate capitalization of $38,912,336. In addition to these, there are 15 companies which are not yet in working order, with an aggregate capital of $15,062,500. The import duty on electric cars and parts is 20 per cent; on electric locomotives, wheels and axles $2.35 per 132 pounds; on insulated wire and cable 20 per cent ad valorem; on incandescent lamps of 32 c. p. or less $2.90 for every 132 pounds. In 1907 the 16 companies had a reserve fund of $496,865, and the receipts had reached the enormous aggregate of $3,828,887, from which a dividend of $1,738,762, or about 7 per cent, was paid, the passenger list for that year amounting to 182,389,707 persons. Though the business has greatly increased, there has been a gradual decrease in dividends, due, it is said, to large flotations of stock.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

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CONTENTS

A Study In Curves

The baseball enthusiast furnishes a colloquial phrase, "getting on to his curves," whose implied admonition may well be heeded by every electrical man, whether engineer or salesman. In this issue is a paper on "Lighting With Metallic Filament Lamps." It was read before a body of engineers who valued it from a scientific standpoint. It traces the difficulties that have been met in the evolution of the incandescent lamp, from the crude beginning to the present perfection. It shows the delicacy of the tungsten filament and explains why this very delicacy is at present limiting its use to the lower voltages. It shows that tungsten has increased the luminous efficiency of the incandescent lamp from three and one-half to eight per cent of the total energy available in the coal pile. This is because of the high temperature and also its property of selective radiation.

The paper also contains in the form of curves the gist of long years of experimenting, so presented that any lamp salesman may explain to a customer how, where and when a certain kind of lamp will save money. These curves graphically show the strong as well as the weak points of the several filaments now used to produce electric light. With such ammunition, the salesman is fortified in his campaign of educating the public in the methods of more efficient illumination.

A little study is necessary to analyze a curve and interpret its meaning, but such study is so well repaid that it is worth the attention of every one. Any point in a curve is a geometrical representation of two numbers which have been laid off along respective reference axes. The curve is obtained by joining a number of these points. By means of such mechanical construction the mind is enabled to mentally reconstruct certain facts with a minimum of effort.

This paper has been cited merely as an example, for to-day there are but few industries whose data or statistics cannot be shown in curve form. Within the past fifty years graphical methods have come more and more into use as an aid wherever laws and rules are considered in connection with numbers. The essential facts of a great array of tabulated figures can be quickly grasped if a few of them be plotted on a diagram. The relations of the numbers are made visually apparent by the substitution of geometric figures for Arabic numerals, and facts laboriously gleaned from long tables may be pictured at a glance by means of diagrams. This economy of intellectual effort is based on the psychological fact that a picture makes a greater impression on the human mind than do figures. The new science of salesmanship is also based on psychology and finds in the picture, and especially the curve, an effective tool for clinching arguments.

PERSONAL.

W. F. Murphy, general manager of the Idaho Consolidated Power Company, is in San Francisco.

Frank W. Eastman is in San Francisco as representative of Stanley & Patterson of New York.

W. V. Whitfield of the Sterling Varnish Company of Pittsburg, Pa., was in San Francisco last week.

W. H. Dickinson has been appointed Seattle manager for the Riter-Conley Manufacturing Company, of Pittsburg, Pa.

T. W. Winsor is expert electrical aid in the department of construction and repair, Puget Sound Navy Yard, Bremerton, Wash.

T. H. Dooling of the San Francisco office of the Electric Storage Battery Company left this week for a short trip to Los Angeles.

A. T. Clark, treasurer of the American Circular Loom Company, and John R. Cole of San Francisco spent the past week fishing at Catalina Island.

R. T. Durrett, vice-president and general manager of the Coos Bay Home Telephone Company at Marshfield, Oregon, was in San Francisco this week.

S. H. Lee, formerly with the Connecticut Company of New Haven, is now with the Portland Railway, Light and Power Company of Portland, Oregon.

R. J. Andrus, formerly commercial agent for the Washington Water Power Company, is now superintendent of the Kennewick-Pasco system of Yakima Valley Power Company at Kennewick, Wash.

Henry M. Steele, who has for the past few years been with J. G. White & Company, Inc., engineers and contractors, 43 Exchange place, New York, as chief civil engineer, has resigned on account of ill health and has removed with his family from New York to Asheville, N. C.

F. N. Boyer, of the Chicago office of the General Electric Company, accompanied by Mrs. Boyer, returned from Honolulu on March 15th. Mr. Boyer has been several months on the Pacific Coast and the Hawaiian islands seeking renewed health and is planning to spend several weeks more in this vicinity, after which he will return to Chicago, where he expects to resume his duties.

TRADE CATALOGUES.

Fort Wayne fan motors are attractively portrayed and specified in Bulletin No. 1114 from the Fort Wayne Electric Works.

An attractive booklet from the Stromberg-Carlson Telephone Manufacturing Company of Rochester, N. Y., portrays the saving of time effected by their telephone equipments.

Catalogue No. 23 from the Chicago Fuse Wire and Manufacturing Company is an illustrated descriptive price list of Union stamped steel switch boxes, outlet boxes and covers

Bulletin No. 1113 from the Fort Wayne Electric Works illustrates and describes their Type M. L. Three-Bearing Belted D. C. Generators with balance wheel for small plants operated by gas engines.

The subject of lubrication is treated in a pamphlet stating the advantages of a pure mineral grease for general lubrication, issued by the Keystone Lubricating Company, Philadelphia.

"Tests of Friction Clutches for Power Transmission," by Prof. R. G. Dukes, a reprint of a paper presented before the last annual meeting of the American Society of Mechanical Engineers, has been issued by the Hill Clutch Company of Cleveland, Ohio.

NEWS OF THE STATIONARY ENGINEERS.

The National Association of Stationary Engineers will hold its sixth annual State convention in San Francisco in June. The committee is made up of members of both of the San Francisco associations, No. 1 and No. 3, including Chairman P. L. Ennor, Secretary A. C. Arbuckle, Treasurer Charles Dick, William Jenkins, James E. Green, John Traynor, H. Noethig, M. W. Herzog, John W. Carter, B. E. George, H. Davis and D. E. Brewer. In addition to the usual papers and meetings arrangements are being made for an exhibit of power machinery at the Auditorium during the week beginning June 14th. Much of the floor space for the exhibits has been already taken by manufacturers and dealers in engineering supplies. The seven subordinate associations in California are working to make this the most successful yet held.

Subordinate Association No. 3, of which W. P. Milner is president and David Thomas secretary, have arranged for a number of talks and lectures on a wide variety of subjects of interest to the engineering and electrical fraternity, of which due notice will be given in the Journal of Electricity, Power and Gas.

The Steam Turbine was the subject of two talks recently given by Mr. W. J. Davis of the San Francisco office of the General Electric Company. On March 24th, at 8:30 p. m., a representative of the Westinghouse Electric and Manufacturing Company will speak on the Parsons turbine at the association rooms in the Merchants' Exchange Building. All those interested in this subject are cordially invited to attend.

DAVID THOMAS, Cor. Sec.

TRADE NOTES.

The Telephone Electric Equipment Company have removed their general offices, sales rooms and warehouse to 612 Howard street, San Francisco.

LOS ANGELES SECTION, A. I. E. E.

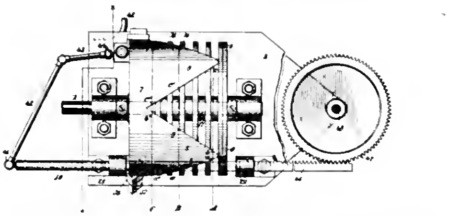
The Los Angeles Section of the American Institute of Electrical Engineers met at the University of California, March 16th. Mr. Clem A. Copeland read an interesting paper on "Transformer Kinks and Wrinkles."

EXAMINATION FOR WIRELESS EXPERT.

The United States Civil Service Commission announces an examination on April 21, 1909, to secure eligibles from which to make certification to fill a vacancy in the position of assistant electrical engineer, expert in wireless telegraphy, in the Signal Service at Large, at a salary of $1,500 to $1,800 per annum, depending upon the experience and qualifications of the appointee, and vacancies requiring similar qualifications as they may occur in any branch of the service. The person appointed to the position for which this examination is held will probably be located for the major portion of his time in Washington, D. C., but he will also be required to travel about the United States visiting wireless telegraph stations, which visits may be of a few days or several months' duration. This examination will consist of theoretical and practical questions in electrical engineering, with special attention to wireless telegraphy and telephony; technical training and experience in the line of the required duties (rated on application). Applicants must indicate in their applications that they have a good general knowledge of electrical science and that they are thoroughly familiar with wireless telegraphy and telephony both in theory and operation. Applicants whose applications fail to show that they have had sufficient training and experience to entitle them to a rating of at least 70 per cent in that subject will not be admitted to the examination.

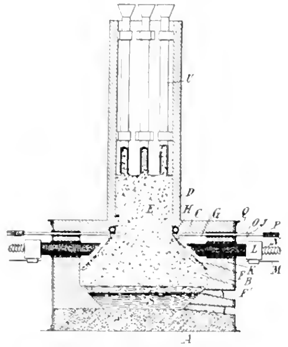
PATENTS

913,753. **Light-Regulator for Electric Lamps.** Thomas E. Murray, New York, N. Y. The combination of a rotary shaft, a plurality of disks of non-conducting material on said shaft, a plurality of tapered plates of conducting material seated in the



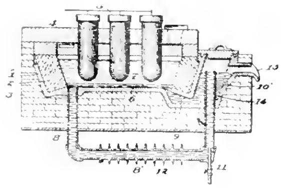
circumferential peripheries of said disks, and a contact bearing on said plates and disks and movable in the axial direction of said shaft.

913,888. **Electric Furnace. Paul L. T. Heroult,** La Praz, France, assignor to Societe Electro-Metallurgique Francaise, Froges, Isere, France. An electric furnace having side walls B for maintaining a column of the charge, an overhanging



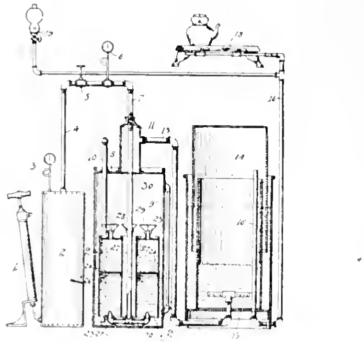
wall C, a shaft D above said overhanging wall and through which the charge is fed, and an electrode beneath said overhanging wall, said parts being proportioned and located to permit the removal of the electrode out of contact with the charge.

914,214. **Electrolytic Process of Producing Nitrogen Compounds.** Charles E. Acker, Niagara Falls, N. Y. The electrolytic process of producing nitrogen compounds, which consists in continuously electrolyzing a molten compound of a



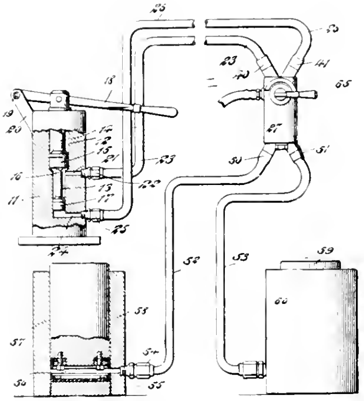
metal capable of forming nitrogen compounds, alloying the separated metal with the cathode metal, removing the alloy and reacting on it with a nitrogeneous reagent, separating the products of reaction, and returning the residual metal to the cathode.

913,733. **Gas-Generator.** James A. Kenworthy, Oakland, Cal. A carbureter comprising a casing adapted to contain volatile oil, a plurality of receptacles therein open at the bottom to the entrance of the oil, a pipe extending to the bottom of the casing, conduits leading from the bottom of said pipe, one for each receptacle, and discharging upwardly



into the open bottom of said receptacle, contracted outlets at the tops of the receptacles, screens arranged horizontally above said outlets, against which the air emerging from the receptacles impinges, a discharge conduit for the gas, and a screen covering the bottom of the discharge conduit, substantially as described.

914,165. **Device for Controlling Hydraulic Pressure.** James W. Nelson, New York, N. Y. In combination, a plurality of means having the common operative means for generating hydraulic pressures, means apart therefrom for combining



said pressures or rendering effective one thereof only and for controlling and distributing the resultant pressure, and means for simultaneonsly applying said resultant pressure at a plurality of selective points.

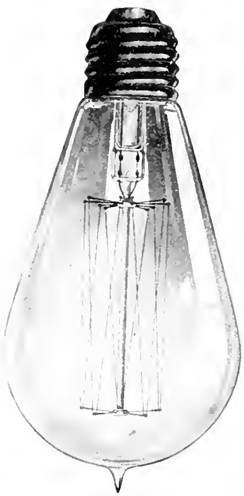
INDUSTRIAL

A NEW SMALL-BULB 40-WATT TUNGSTEN LAMP.

Several months ago a 25-watt Tungsten lamp was placed on the market with a bulb practically the same as used in the familiar 16-candle-power carbon lamp and which could be used as a substitute for the carbon lamp in any fixture or shade. This lamp came into immediate favor and general use, but it lacked one of the chief advantages of the use of Tungsten filament lamps—a large increase of illumination without increasing the current consumption.

The General Electric Company has recently placed on the market a small bulb lamp with a 40-watt Tungsten filament giving double the candle power of the present 16-candle-power carbon lamps, but taking only four-fifths of the current. This lamp, when substituted for the carbon lamp, will therefore not only materially reduce the cost to the customer, but will greatly increase the standard of illumination by doubling the quantity and bettering the quality of the light given.

As seen by the accompanying illustration, which shows the lamp in about two-thirds size, the bulb and base are



40-Watt Tungsten Lamp.

practically the same as that of the ordinary incandescent carbon lamp.

This new 40-watt lamp contains all of the many improvements in filament construction and methods of support perfected by the General Electric Company, and truly represents the latest and best development in Tungsten lamp manufacturing. Like other General Electric Tungsten lamps, it can be burned in any position without affecting its life or candle power, and its small bulb adapts it to all ordinary shades, chandeliers and brackets.

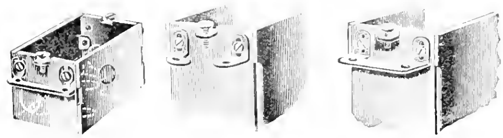
Its price is less than that of the regular large-bulb Tungsten lamp with shoulder base, and the operating cost, including cost of lamp and current, is less than any incandescent lamp smaller than the 60-watt Tungsten. Furthermore, the customer is not required to include in the purchase of the lamp a new outfit of special fixtures, shades, etc. From a commercial standpoint, therefore, it is the easiest selling lamp on the market and is of additional value to the central station in maintaining the revenue from its customers.

The new small-bulb 40-watt lamp can be used in installations now using the old type with shoulder base and Holophane reflectors by changing the shade holder from the "H" type to the "O" type. This will raise the reflector around the lamp so as to bring the filament in correct "focus" and obtain practically the same efficient distribution of light from the reflecting and refracting prismatic surfaces.

"UNION" SHALLOW SECTIONAL SWITCH BOXES.

To accommodate the growing demand for shallow switches and receptacles that has lately induced the makers of this line of goods to bring out a shallow type switch, the Chicago Fuse Wire and Manufacturing Company has designed two shallow boxes of the sectional type construction, to be employed in thin partitions, outside walls, and where there is not ample room, or where it would entail additional work in cutting away the material, to install a deeper box.

The "CCS" or loom box as shown in single in Fig. 1 is two inches deep, outside dimensions, and will take all makes



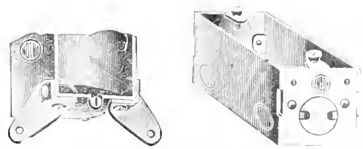
Figs. 1, 2 and 3—Shallow Sectional Switch Boxes.

of shallow switches and receptacles. The switch lugs are drilled on standard centers, and being formed outward, enable the body of the box to be made short enough so that the attachment ears are effectually covered by the flush plate when used in old work.

The "CCS" box is provided with two knock-outs in each end, but has none in the back. It may be equipped with any of the three types of ears shown in Figs. 2, 3 and 4.

It may be built up into gangs from the single box, as well as from the 2-gang, and the hook-eye construction being used throughout allows the spacers to be inserted without removing screws, which avoids the danger of their being lost in the operation.

Fig. 2 illustrates the regular type "F" ear, which is always furnished on "union" switch boxes, unless one of the



Figs. 4 and 5—Shallow Sectional Switch Boxes.

other types is desired; has the well-known sliding adjustment and reversible feature so that it may be set to various depths when used in new work, according to the thickness of the plaster, and being supported by pivoted connection, they may be turned at any angle to enable striking of the lath, which is particularly convenient in old house wiring.

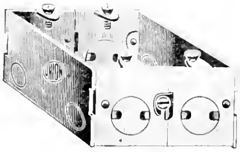
Fig. 3 shows type "C" ear, which for certain places is desirable, especially when used in connection with a rotary flush switch in which the plate has no supporting screws, the ears, being recessed into the plate, help hold it more rigidly in place.

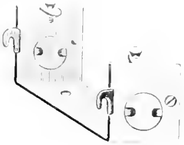
Fig. 4 shows the type "SF" ear, which is used only in connection with new work, is often preferred where a strong

anchorage of switch box is desired; the attachment screws being farther from the edge of the supporting strips, are less likely to split or pull out.

This ear is also provided with an adjustment slot, so that the face of the box may be brought out three-quarters of an inch to seven-eighths of an inch from the plaster line, and being of stamped steel, there is no danger of them breaking off by falling or by being twisted at an angle, as frequently occurs in the case of cast-iron switch frames.

In Figs. 5 and 6 the No. 170, or shallow conduit box, is shown in single and 2-gang, while Fig. 7 shows the spacer used to build the box up into any number of gangs. This wall case measures four inches long, two inches wide and seven-eighths of an inch deep, outside dimensions, and has switch lugs spaced to take all makes of standard shallow switches and receptacles. As shown in cut, this is a combination loom and conduit box having entrance at each end for one-half-inch conduit or "BX" armored cable, and two





Figs. 6 and 7—Shallow Sectional Switch Boxes.

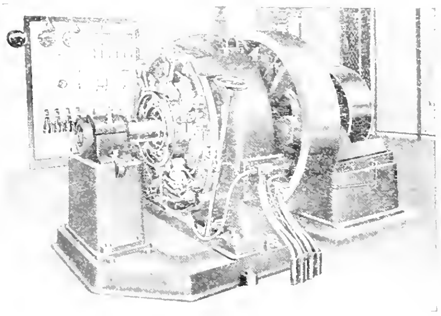
five-eighths-inch openings on either side for loom, these being located as far from the center as possible so that the ends of the tubing will not interfere with installation of the switch.

The box, being one and seven-eighths inches deep, particularly lends itself to use in outside walls where a one-inch ferring strip is used on the brick and a one-quarter-inch lath, leaving five-eighths of an inch for plaster, in which case the conduit can be run back of the lath, and it is not necessary to recess the box in the brick wall. This box is also equally suitable where thin partions are constructed with one-inch uprights for holding of the lath. The combination of conduit and loom outlets in the same box makes it particularly adapted to use where changes are made from conduit or open work.

A flat steel cover can be furnished for this box, which makes it an excellent small junction or pull box, and when desired in new work it can be equipped with either of the ears noted above at a price corresponding to the "CCS" box.

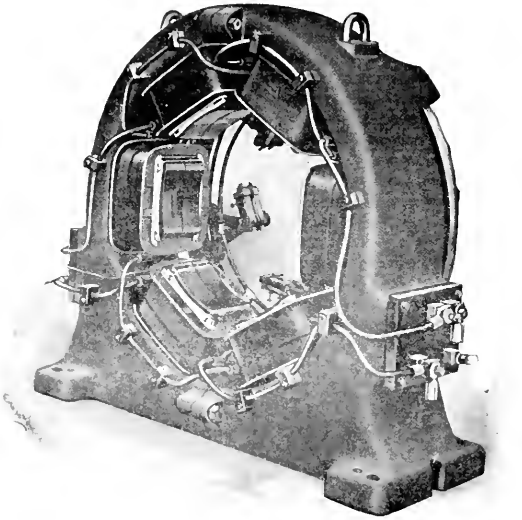
THREE WIRE GENERATORS.

Of the many new features embodied in the design of three wire D. C. generators recently put on the market by the



75 K. W. 3-Wire Generator Installed in the Plaza Hotel, Chicago.

Western Electric Company, the most distinct is a doubly wound armature which is employed for obtaining the neutral e. m. f. point. The coils of this balancing winding lie beneath the usual armature winding and at the bottom of the slot, which is made deeper for this purpose. This winding is interconnected with the main armature winding and with a slip ring in such a way that the slip ring always possesses a potential midway between the potentials of the two



3-Wire Generator with Armature Removed, Showing the Series Field Connection.

brushes. The section of the copper in the auxiliary winding is very liberal, thus keeping the current density low and enabling the machine to take care of very large unbalanced loads without injury to any part. The voltage regulation is close even under sudden or large changes in the unbalanced loads.

In order to compound for the total load on the generator under all conditions, the series field winding is divided into two parts, one-half of the coils being connected to one terminal of the armature and the other half to the other terminal; the coils on alternating poles being connected to the same side of the armature. The liability of the breaking down of the insulation is reduced to a minimum since coils having the full potential of the machine between them are not placed on the same pole. This arrangement further results in perfectly balanced magnetic and electric circuits. The neutral wire is connected to the brushes, which rest on the collector rings, electrically insulated from, but mounted at the end of the commutator. This simple construction is possible because no shifting of the neutral brushes is required no matter what amount of overload is carried.

During the process of manufacture, all parts are subjected to rigid inspection, and tests, and the completed machines are tested under load for a sufficient length of time to assure that they come within the guaranteed limits of heating and sparkless operation. The insulation of the various parts of the machine and the completed machine are tested by the application of high voltage.

CUTLER-HAMMER CO. OPENS CLEVELAND OFFICE.

The Cutler-Hammer Manufacturing Company of Milwaukee, makers of electric controlling devices, announce the opening of a District Office in Cleveland, Ohio—1108 Schofield Building. The new office will be in charge of Mr. C. J. Kruse, who comes from the Engineering Department of the Cutler-Hammer Company and who is well qualified to advise regarding the proper device to use in any case involving the control of electric motors.

SOME RECENT TANGENTIAL AND TURBINE WATER WHEEL PRACTICE.

BY GEORGE J. HENRY.

The work by the principal manufacturers in this field in recent years has been marked by some radical improvements both in the design and adaptation of tangential water wheels for operating under comparatively high pressure, and also in turbines for handling larger volumes of water under low pressures.

The development of power, especially on the Pacific Coast, has been tending towards the operation of larger units under lower pressures and of course requiring correspondingly increased volumes of water. This tendency is attributable to several causes, [illegible] sive high pressure [illegible] close [illegible] markets have been [illegible] in the [illegible] necessary to go [illegible] making [illegible] high and uncertain cost [illegible] a lower point on the mountain slopes, where [illegible] seldom as great. The phenomenal growth of the commercial development in the Western States has also made the market much more secure for investors in this industry, and the manufacturers' practice has become sufficiently crystallized and assured to further accentuate this point.

Indeed, manufacturers have also been putting forth great effort in this line and the reliability of hydraulic power-house apparatus is becoming more and more assured. On the other hand, water power development has been handicapped to a considerable extent on account of the uncertain financial conditions throughout the country during the past several years, creating an uncertain and low bond market which discouraged the promotion of new enterprises such as these, which depend almost entirely upon bond issues. It is, of course, hoped that a brightening of the financial outlook during the coming year will result in a considerable impetus to this industrial development.

From the manufacturer's standpoint, there is constantly a strong tendency imposed by the purchasers of water wheel apparatus to cheapen the product, the average purchaser of water wheels has not had sufficient experience with this class of machinery to readily understand the necessity for the highest grade of construction, and in fact considers this of secondary importance only, when compared with the first cost, as it influences [illegible] by [illegible] In fact the [illegible] cost per horsepower expended on the water [illegible] equipment, [illegible] difference in the total cost per unit of [illegible] of the plant and [illegible] to insure the most successful operating conditions and [illegible] the most permanent and safest investment, bringing [illegible] and satisfactory returns.

From the standpoint of machine design, it is of course advisable to simplify the mechanical features to the maximum point. On the other hand, there are [illegible] more variables entering into the design of water wheel apparatus where it is properly adapted to meet the individual conditions in any particular plant, than in any other class of machinery, and for this reason it is impossible for a conscientious manufacturer to attempt to standardize water wheel units to any extent. Some of the individual parts, such as gate valves, bearings, etc., can

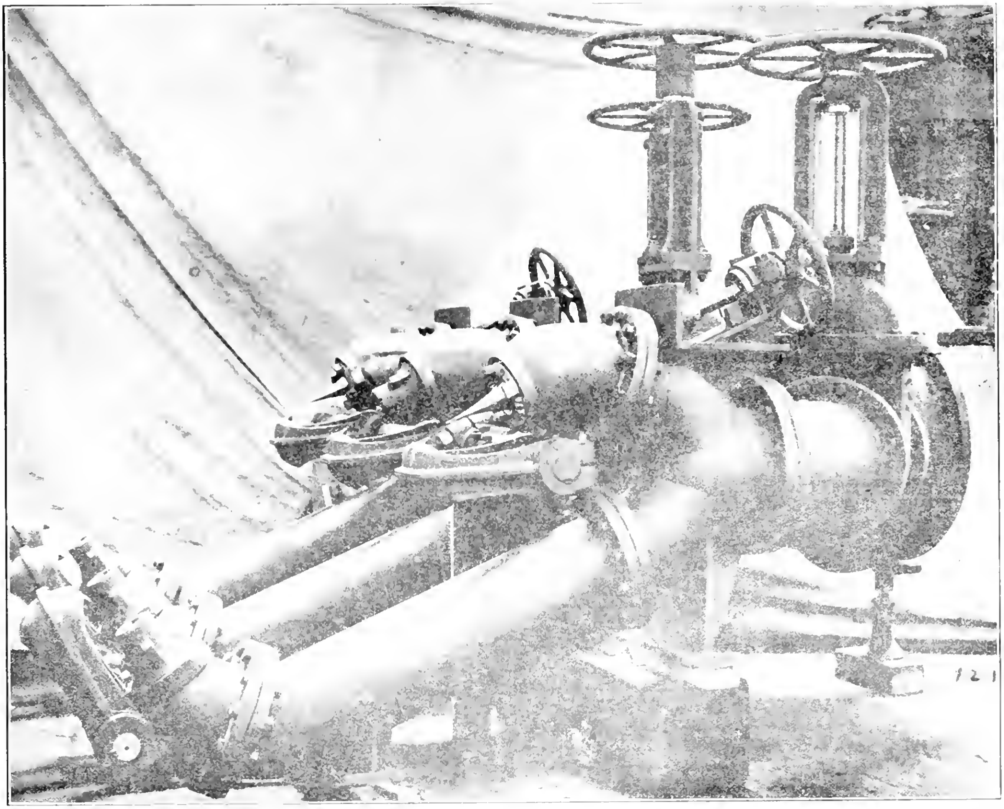


Fig. 2. Triple Double Nozzle for Impulse Unit, Equipped With Counterbalanced Stream Deflectors for Hand-Controlled Needles.

to a certain extent be standardized; but in order to use them in a rigid and built-up structure forming a "prime mover" unit, involves in every instance expensive pattern changes and development charges; and in order that the manufacturer may be properly prepared to duplicate any parts of the apparatus in the event of their becoming worn or damaged in operation, lost in transportation, etc., it is highly advisable that complete jigs and templets of at least all the important parts be retained. This is, of course, a very expensive item, which it is hard to convince the average purchaser is a good investment. The writer believes it will be found to have been the experience of most water wheel manufacturers that it is always easier to demonstrate the monetary value in hydraulic apparatus to a purchaser who has had considerable previous experience (the more the better) and that such a purchaser does not hesitate at any expense which secures for him simplicity, interchangeability, rigidity and the introduction of any and all devices that make absolutely continuous and efficient operation most certain. In negotiating the sale of such apparatus to a purchaser unfamiliar with it (as is very frequently the case where promoters or financial agents carry on the negotiations), a campaign of education along the above line is almost essential.

The value of water is becoming more and more important in almost all power plants; and in the case of tangential water wheels any control of the water flow in high pressure and unusually long pipe lines involves the very serious question of water ram—one of the most dangerous factors to contend with in power house design. The use of the stream deflector operated

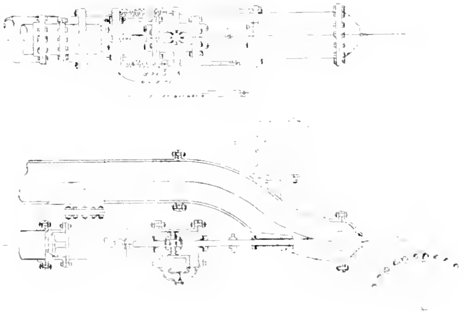


Fig. 1. Pelton By-Pass Nozzle.

by an automatic governor and the hand control of regulating needle valves to a very considerable extent serves the purpose of economizing the water that would otherwise go to waste during those hours of the day or year when the plant is operating below a maximum capacity. On the other hand, however, while such apparatus may be built for water economy, depending on the attention of the power house operators, such attention is not always given, and in many instances the manufacturers and engineers of power plants are not particular to instruct the operators regarding this important feature. The writer has frequently seen such nozzles wasting water from a storage reservoir which would be worth considerable before the season is [illegible] as a little attention on the part of the operator in adjusting the needle to the daily or hourly requirements would [illegible] water in the reservoir, enabling the power company to [illegible] much better peak load during the very dry months.

[illegible] of the by-pass nozzle (see article by the writer in [illegible] of the American Society of Mechanical Engineers, 1906, and U. S. Patent 853786) to a considerable extent [illegible] this defect and makes the water saving automatic. [illegible] renders the tangential water wheel the equivalent [illegible] regulated by wicket gates, and having a slow-closing [illegible] rigidly connected to the gate ring and the govern-[illegible]

Fig. 1 illustrates this nozzle. The simplicity of its design, the few connecting parts and the impossibility of dangerous water ram occuring, make this form of nozzle a decided step in advance of the combination stream deflector and needle nozzle. On account of the constant demand for larger power units, the use of the deflecting nozzle is rapidly giving place to the counterbalanced stream deflector, which is a very much lighter device and one entirely independent of water pressure, except to a slight extent when it is operating within the stream range. The load on the governing mechanism for operating such a deflector is therefore very much less, enabling lighter and cheaper governors to be used. The great reduction in the inertia of the moving parts enables the control, with an equal governor effort, to be much quicker and the regulation correspondingly more sensitive and accurate.

Fig. 2 shows a triple double nozzle for an impulse unit equipped with patented counterbalanced stream deflectors and hand controlled needles. These Pelton counterbalanced stream deflectors have been used on all sizes of units up to 5000 k. w. output and under operating pressures in excess of 1900 feet with the highest degree of success; and in cases where more than one

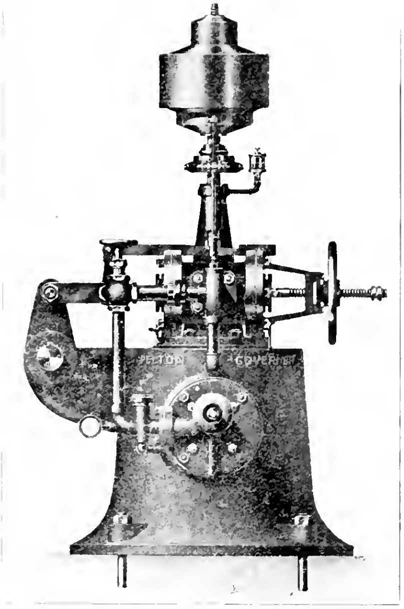


Fig. 3. Modern Pelton Governor.

nozzle is used on a wheel are the only means of satisfactorily controlling the speed without water ram.

Great strides have also been made in governing apparatus. The modern Pelton governors (Fig. 3) are characterized by a highly sensitive centrifugal element having a very large moving effort for an extremely slight speed change. The governor shown in the illustration puts forth in excess of 20 pounds for shifting the valves controlling the oil pressure flow to the operating cylinders on a speed change of 1%. Such effort shifts a pilot valve, the motion of which is instantaneously followed by a secondary valve of much larger port areas, enabling a complete stroke of the governor cylinder in 1½ seconds. The governor is equipped with independent hand control and electric control from the switchboard, with patented automatic safety lever, causing a closing down of the plant in the event of the governor belt running off or being broken. It is also provided with adjustable relay and returning devices, and is about as simple and efficient

in its operation as a governor can be constructed. Its design has been carried out exclusively for the control of Pelton tangential wheels and Pelton-Francis turbines; and it is provided with self-contained oil pumps, unloading valves and all connections; the entire governor apparatus being complete in one machine, thus avoiding the necessity for skilled labor to secure its proper installation, as also the usual complicated network of pipes. It has no vacuum system, using oil under pressure only, thereby eliminating one of the most frequent causes of governor trouble in the earlier power houses. The governor is made in several sizes up to 25,000 feet pounds capacity and the same principles of design are also carried out in a mechanical governor, as shown in Fig. 4, which contains no oil system, and of course is suitable only for controlling comparatively small units.

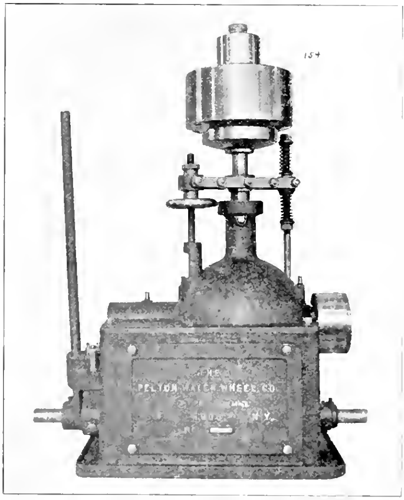


Fig. 4. Pelton Mechanical Governor.

A brief description of a few of the more recent installations and some of the special features involved therein will probably be of interest.

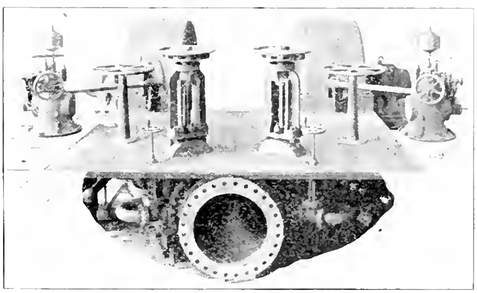


Fig. 5. Plant of Northern Light and Power Company.

The plant of the Northern Light and Power Company is illustrated in Fig. 5. This consists of two 1500 h. p. Pelton units each driving a 750 k. w. generator at 450 rpm., the wheels operating under an effective head of 680 feet. Each unit is controlled by a Pelton oil pressure governor and deflecting nozzle. In this case, water storage is not available, and hence regulation is accomplished exclusively by deflecting the stream.

Fig. 6 (photo page 179, issue of JOURNAL March 6, 1909) illustrates a water wheel recently constructed by the Pelton Water Wheel Company (after designs by Mr. W. R. Eckart) for driving a 5000 k. w. unit at the Electra plant of the Pacific Gas and Electric Corporation. This wheel develops the full capacity with a single jet of water, operating under about 1400 feet head. The method of attaching the buckets is unique. The wheel center is of nickel steel (in two pieces) and the buckets are attached with two nickel steel bolts each driven in reamed holes. This wheel replaces one of other manufacture.

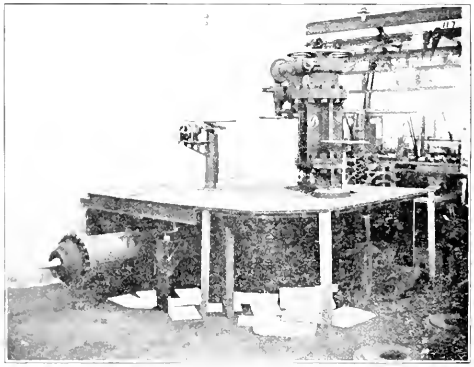


Fig. 7. Arrangement of Nozzle Gate and Floor Plate for Stanislaus Power Company.

Fig. 7 shows the arrangements of the nozzle, gate and floor plates for one-half of one of the units of the Stanislaus Power Company, whose 30,000 h. p. plant on the Stanislaus River has been in operation with the highest degree of success for a number of months past. In this case, the position of the needle valve is controlled electrically from the switchboard. The gate valve is of the outside screw and yoke, bronze mounted, single disc Pelton type, with oil packed roller thrust bearings; and has both quick and slow motion hand control, cast steel by-pass and water motor control for operating in either direction with automatic cut-outs. The wheel units in this case are of the well known

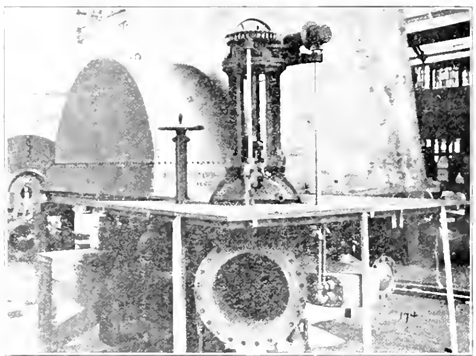


Fig. 8. High Pressure Cast Steel Pelton Gate Valve.

Pelton overhung construction, i. e., one water wheel mounted on each end of a single shaft with an engine type 6750 k. w. General Electric generator mounted between the bearings. The plant has been thoroughly tested out and the wheels give both efficiency and overload in excess of the guarantees. These are the largest tangential water wheel units in the world, each unit having developed in excess of 15,000 h. p. The automatic control is effected through deflecting nozzles operated by special Pelton

oil pressure governors with switchboard control, safety levers, self-contained oil pumps and unloading valves.

The exciters are of the single overhung type with Pelton governors and induction motors.

Fig. 8 shows a high pressure cast steel Pelton gate valve with all pressure parts mounted below the floor and hand and reversible water motor control and automatic cut-out.

Fig. 9 shows a complete iron-mounted type of Pelton unit, well adapted to the requirements of the average mining plant.

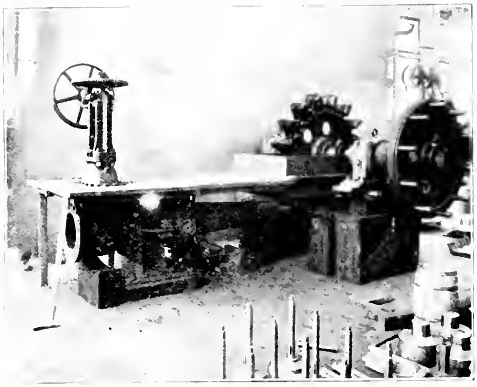


Fig. 9. Pelton Unit Adapted to Mining Plant.

This equipment was constructed for the Hazel Gold Mining Company of Trinity County, for operating under an effective head of 680 feet and for direct connection through a flexible leather link coupling (one half of which is shown in the cut) and solidity. The wheel centers and buckets are of cast steel and the bearings are of the Pelton generator type.

As regards some of the characteristic features of Pelton-Francis turbines, attention is directed to Fig. 10. This shows controlled by an automatic Pelton governor (not shown in the

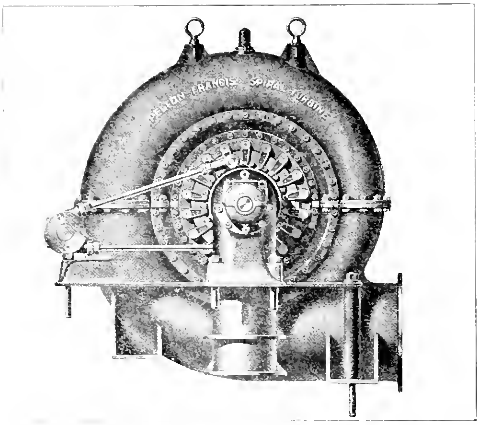


Fig. 10. Outside Wicket Gate, Controlling Ring and Wrist Plate Connections to Pelton Governor.

cut) and the entire construction is characterized by simplicity ... 550 k. v. a. 450 rpm generator. The deflecting nozzle is ... outside wicket gate, controlling ring and wrist plate connections to the Pelton governor, also the rigidly connected by-pass valve operating below the floor line, the generator type bearings, ...ated gate valve, pressure and vacuum gages and spiral case. Fig. 11 shows these governor connections and by-pass valve, together with the slow returning oil dashpot, effecting water economy without water ram in the pipe line.

Four 5000 h. p. vertical type Pelton-Francis turbines running at 300 rpm. under an effective head of 147 feet have been in operation for some time at the plant of the Schenectady Power Company, transmitting power to the General Electric Company's works at Schenectady, N. Y. These are mounted on the vertical shaft of the generator, which is extended below the floor line,

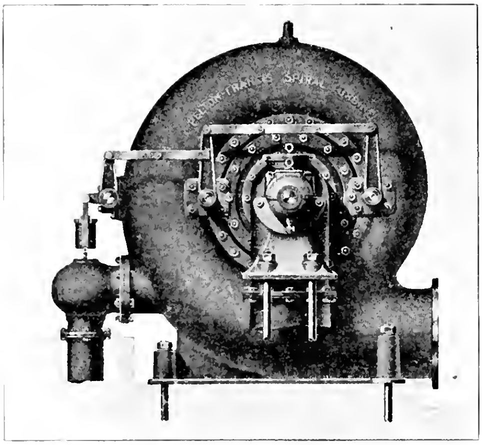


Fig. 11. Governor Connections and By-Pass Valve.

bringing all of the water pressure pipes and connections beneath the floor. The weight is carried by roller bearings running in oil, and the bearings are relieved of about 75 per cent of the weight of the rotating element by the design of the turbine runner, so as to make use of the reaction.

In the same plant there are 250 h. p. horizontal shaft Pelton-Francis turbines driving the exciters at 600 rpm.

At the plant of the Claremont Power Company, Cavendish, Vt., there are three 750 h. p. 600 rpm. double horizontal shaft

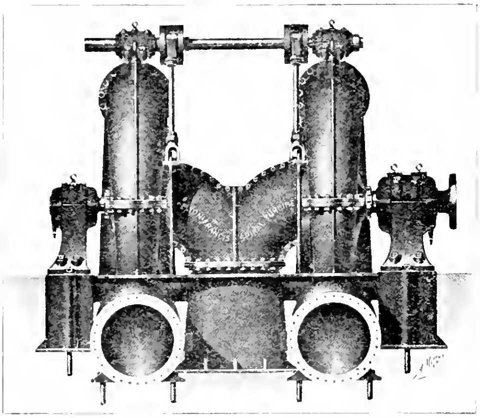


Fig. 12. Pelton Francis Spiral Turbine.

Pelton-Francis turbines, operating under an effective head of 120 feet.

At the plant of the Black Hills Traction Company, near Spearfish, So. Dak., there are two 1100 h. p. 400 rpm. horizontal shaft, double Pelton-Francis turbines, operating under a head of 110 feet.

The Pelton-Francis type of turbine is characterized by its high efficiency, which has, in numerous cases, exceeded 85 per cent.

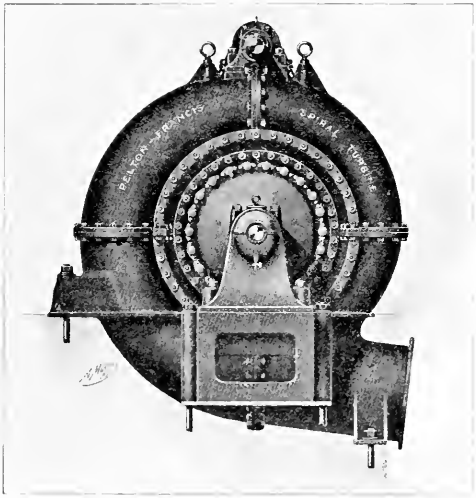


Fig. 13. End View of Pelton Francis Spiral Turbine.

Fig. 12 shows the type of turbine of which two are now being constructed, of 1200 h. p. capacity each, under an effective head of 45 feet and direct connected to 300 rpm generators. This illustrates the rigidity of the governor connections, the generator type bearings and the smooth curvature given to all of the water channels. An end view of the same turbines is shown in Fig. 13, which illustrates more clearly the spiral case and the method of bolting together the various parts so as to enable the turbine to be readily dissected, every heavy piece, including the runner, being easily handled by the crane.

Fig. 14 illustrates the form of turbine now under course of construction for the Utah Light and Railway Company for their Devil's Gate plant, having a capacity of 5000 h. p. at a speed of 360 rpm. and for operating under an effective head of 142 feet.

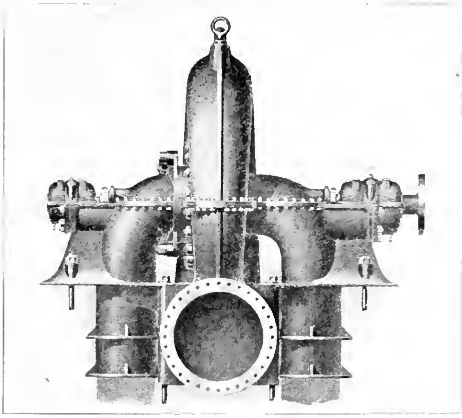


Fig. 14. Turbine for Utah Light and Railway Company.

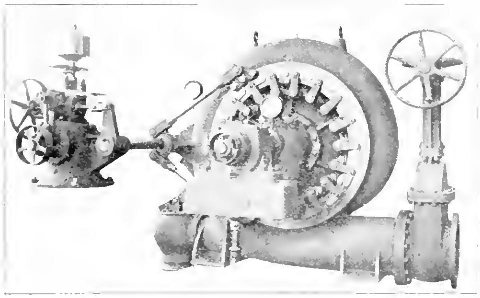


Fig. 16. End View of Turbine for Utah Light and Railway Company.

Fig. 15 shows one end view of this turbine with the water relief valve with slow returning oil packed dashpot, and Fig. 16 shows a view of the other end of this unit with the governor wrist plate, external gate operating connections, etc.

In addition, there are now also under course of construction two 4000 k. w. water wheel units, one 2000 k. w. and two 1000 k. w. units of the Pelton tangential type.

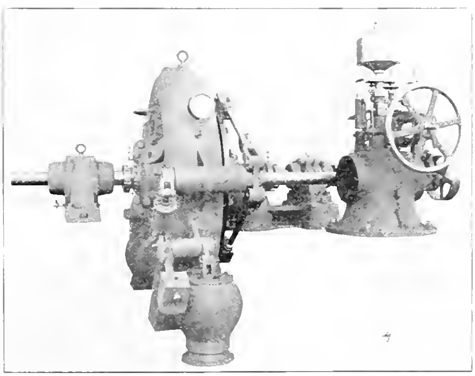


Fig. 15. End View of Turbine for Utah Light and Railway Company.

MACHINERY HAULAGE

The accompanying illustration shows a thirty-ton condenser for the City Electric Company, San Francisco, which required twenty-four horses to haul from the freight sheds to the company's plant at the foot of Mason street. This

work was done by the Jones Draying Company. The work of delivering heavy machinery to power plants requires great care, as the apparatus is often put on the foundation by the haulers. Many large power plants are built directly on the line of railroads, but in large cities this is often impossible, reliance being placed upon teams.

NEWS NOTES

INCORPORATIONS.

BAKERSFIELD, CAL.—The La Blanc Oil Company has been incorporated here with a capital stock of $250,000 by John La Blane and others.

RIVERSIDE, CAL.—The Tahoe Park Land & Water Company has been incorporated here with a capital stock of $24,800 by W. J. G. Lambert, E. L. Lambert and G. E. Dole.

RIVERSIDE, CAL.—The Coral Reef Land & Water Company has been incorporated here with a capital stock of $10,000 by C. L. Hall, E. H. Kellar, W. T. Kendrick and J. W. Utter.

RIVERSIDE, CAL.—The Corona Pumping Company has been incorporated here with a capital stock of $25,000 by M. L. Coleman, J. Adams, A. O. Hall, Priestly Hall and J. B. Knight.

SAN FRANCISCO, CAL.—The Tri-County Oil Company has been incorporated here with a capital stock of $5,000,000 by H. G. Platt, D. M. Burns, J. J. Moore, A. D. Shephard and R. Bayne.

OAKLAND, CAL.—The Associated Pipe Line Company has been incorporated here with a capital stock of $7,000,000 by E. E. Calvin, G. L. King, W. F. Herrin, W. S. Porter and F. H. Buck.

FRESNO, CAL.—The Section Thirty Oil Company has been incorporated here with a capital stock of $200,000 by W. L. Evans, of Lancaster, Pa.; G. W. Strominger, of Berkeley; A. D. Windsor, T. C. Gray and Paul Koched, of San Francisco.

BERKELEY, CAL.—The Sierra Electric Power Company has been incorporated with a capital stock of $500,000 by F. E. Horton, Benjamin F. Woolner, T. C. Warren and Boyd L. Wilson. Water rights have been secured on Battle Creek, Tehama county, and a power plant costing $500,000 is being constructed there. Attorney Greer, representing the company, has applied to the Supervisors of Butte county for a franchise to erect power lines in that county, and April 6th has been set by the Supervisors as the date of sale.

TRANSMISSION.

GLENDALE, CAL.—The City Council has passed a resolution for the construction of a municipal electric light and power plant in this city.

QUINCY, CAL.—The Round Valley Water Company was granted a franchise this week to construct power lines along the highways in Indian township.

RED BLUFF, CAL.—Secretary F. C. Wilson, of the Sierra Electric Power Company, has asked for a franchisee to construct electric power lines in Tehema County.

BAKERSFIELD, CAL.—The Kern Power, Transit & Light Company has begun rebuilding its power line from this city to the power station in the Kern River Canyon.

INDEPENDENCE, CAL.—Henry Rainey, representing the J. Levering Jones and Reward & Brown companies, visited this city last week for the purpose of finding desirable property for building a power plant.

CHICO, CAL.—As a result of the application of Frank C. Wilson, representing the Sierra Electric Power Company, bids will be received by the City Council till April 2, 1909, for the sale of a fifty-year franchise for the transmission of power in this city.

SAN FRANCISCO, CAL.—Word has reached this city from Parral, Mexico, that President G. F. Greenwood, of the Mexican Northern Electric Company, is now in that city securing a site on the Conchas river, near Parral, for the erection of a $5,000,000 electric power plant.

HORNBROOK, CAL.—The Siskiyou Electric Light & Power Company is now at work on the new power line from Snowden to the mines on the Klamath river. The company plans about April 1st to begin building its power line through Little Shasta Valley to Sisson and Dunsmuir.

GOLDFIELD, NEV.—The Nevada-California Power Company is to begin within a few months to extend its electric power line from Tonopah to Ely, Nev., a distance of 150 miles. By this extension a number of large power consuming plants will be reached which are now manufacturing their own power.

BAKERSFIELD, CAL.—John McWilliams, Henry Martens and others have purchased 8,000 acres along the banks of the Kern river, near the Kern river oil fields, for the purpose of building an electric power plant. By securing this location a great many of the engineering difficulties are overcome, and a fall of over 250 feet is secured.

SAN FRANCISCO, CAL.—Vanderlynn Stowe, receiver for the Tuolumne Water Power Company, and George H Whipple, receiver for the Stanislaus Electric Company, have been granted orders by Judge de Haven for the maintenance of the properties of these companies. Mr. Stowe was allowed $5,000 and Mr. Whipple $12,000 per month.

VISALIA, CAL.—The suit of the Platt Iron Works, of Los Angeles, against the Mt. Whitney Power Company, to recover $6,907.74 alleged balance due on the purchase of $16,475 worth of machinery for the company's plant on the Kaweah river, in Tulare County, has been transferred from the Superior Court of Los Angeles to the Superior Court of this city.

BODIE, CAL.—Plans are being made for locating two power plants in this vicinity, one on Rush creek, capable of producing 15,000 horsepower, and the other on Leevining creek, capable of producing 15,000 horsepower. A number of owners of mines and mills here have expressed their desire for electric power, and before the coming summer all will be in readiness to supply them.

GRASS VALLEY, CAL.—Chief Engineer Trow, representing the California Midland Railroad Company, is now engaged in making surveys for a twelve-mile ditch which is to carry sufficient water to generate several thousand horsepower at a point on the Yuba river, not far from Smartville. The estimated cost of completing the ditch is $300,000. It is understood that the electric power is to be utilized in operating the company's trains.

SAN FRANCISCO, CAL.—The Great Western Power Company has completed the necessary repairs on the nine miles of its steel cable towers which were blown over by the storms of last January. The power line from Sacramento to Oakland is now complete and power can again be supplied to the Bay cities. The steel towers which were originally imbedded in the earth, are now set in foundations of concrete, so that it will be impossible for the strongest winds to overturn them.

SAN FRANCISCO, CAL—Attorney Charles P. Eels, represening James K. Moffitt, J. D. Galloway, H. P. Goodman and E. H. Rollins & Sons, bond holders in the Stanislaus Electric Power Company, Stanislaus Electric Railway Company, Tuolumne Water Power Company and the Union Construction Company, was authorized this week to contest the foreclosure of a mortgage held by the Knickerbocker Trust Company, of New York, against these companies. The other defendants have filed answers consenting to the foreclosure of the mortgage and the sale of the properties.

TELEPHONE AND TELEGRAPH.

MADERA, CAL.—Thirty thousand dollars has been subscribed for the proposed gas plant in this city.

AZTEC, N. M.—The Eden Canal, Land & Power Company has begun construction work on its electric light plant in this city.

ONTARIO, CAL.—The City Council has granted a franchise to J. R. Anderson for construction of an electric light and gas distributing system in this city.

BERKELEY, CAL.—The Pacific Telephone & Telegraph Company has about completed a number of improvements in this city which will cost upwards of $75,000.

ELY, NEV.—A new company has been formed here to be known as the Spring Valley Telephone Company. The incorporators are Henry C. Nicholson, Joseph E. Stevens and Eugene Giles. The company proposes to build a telephone line from Muncey to Osceola.

TRANSPORTATION.

GLOBE, ARIZ.—George P. Hunt has been granted a 25-year franchise to build an electric line in this city.

MODESTO, CAL.—The Modesto Empire Traction Company has completed plans for the route of its proposed line.

BERKELEY, CAL.—The new cross-town Dwight Way electric line of the Oakland Traction Company is now in operation.

VALLEJO, CAL.—Manager M. McIntyre, of the Napa Valley Electric Railway Company, is now in this city pressing his claims before the City Trustees for a new franchise in this city.

VALLEJO, CAL.—Randall, Wright & Trowbridge, of Oakland, have applied to the Board of Supervisors for a franchise to construct an electric road to White Sulphur Springs and Benecia.

SAN FRANCISCO, CAL.—After March 1st the United Railroads will pay to the State Harbor Commissioners, for the private privilege of operating its cars on East street, $250 per month.

SPOKANE, WASH.—Plans for electrifying the Chicago, Milwaukee & Puget Sound Railroad, the extension of the Chicago, Milwaukee & St. Paul Railroad west of Mobridge, S. D., have been announced by C. B. Pride, hydraulic engineer in charge, with headquarters in Spokane. Sites for power plants have been purchased on the St. Joe river in Idaho and on the Missoula river in Western Montana. The Idaho division of the Chicago, Milwaukee & Puget Sound Railroad extends from St. Regis, Mont., to St. Joe, Idaho, a distance of 106 miles over the Bitter Root Mountains. The initial capacity of the two plants to be constructed this summer will be 30,000 horsepower. Other sites for plants have been located and will be purchased and developed if the future demands it.

SPOKANE, WASH.—Official announcement is made by M. Hall, president of the Spokane, Wallace & Interstate Railway Company, who is also manager of the Federal Mining & Smelting Company, in the Coeur d'Alenes, that the system including an interurban line from Wallace to Spokane, 85 miles, and branch lines from Wallace to Burke and Mullan, Ida., will be built this year. Work is to begin in June and the line will be rushed to completion. Mr. Hall says the survey follows the Coeur d'Alene valley, crossing the divide at a point between the Coeur d'Alene river and Wolf Lodge bay, near Dudley, Ida. It will skirt Coeur d'Alene lake until the city of Coeur d'Alene, 34 miles east of Spokane, is reached. He is not ready to give out the route for the line to Spokane. He said: "Ample power has been arranged for to operate the new line. We will run two, three or four coach trains each way between Spokane and Wallace and will make the trip in three hours. Trains will be run every two hours out of Wallace to Wardner, Mullan and Burke. It will be in shape to handle an immense freight traffic and will accommodate westbound ore shipments."

WATER.

IMPERIAL, CAL.—The City Trustees propose issuing bonds to the sum of $50,000 for constructing a municipal water system.

EUREKA, CAL.—The Eureka Water Works Company is to spend between $70,000 and $100,000 on improving its plant this year.

NEWMAN, CAL. — The City Trustees propose issuing bonds to the sum of $20,000 to provide for a municipal water system.

OROVILLE, CAL.—W. S. Hanscom and J. H. Kimball have applied for a franchise to construct a water system in the suburbs of Paradise.

SAN LUIS OBISPO, CAL.—The City Council proposes issuing bonds to the amount of $60,000 for improving the water system of this city.

YUBA CITY, CAL.—Bids will be received till March 22, 1909, by City Engineer McMutry for the erection of a municipal water system in this city.

COLUSA, CAL. — The Supervisors have granted the petition of C. K. Sweet asking for the right to lay pipe lines in Williams and Zumwalts.

RHYOLITE, NEV. — The Pioneer Water Company has asked for the right to construct a pipe line from Bryan and Crystal Springs to Pioneer.

SANTA BARBARA, CAL.—Bids have been received for the supplying of materials for the pipe line from south portal of Mission tunnel to Mission reservoir.

LOS ANGELES, CAL.—Harry A. Williams has purchased 40 acres of land near Lindsay, where he will sink a well and install an electric pumping plant.

GRIDLEY, ARIZ.—President Fred G. Moesch, of the Board of Trustees, will receive bids up to March 25, 1909, for furnishing 10,000 feet of two-inch standard wrought-iron pipe.

BISBEE, ARIZ.—Contracts for bids have been awarded to the United States Pipe Company for furnishing cast-iron pipe to be used in constructing the proposed fire protection system.

SAUSALITO, CAL.—Bids will be received till March 22, 1909, by City Clerk John E. Kipp, for furnishing materials and labor for the construction of six water storage tanks in this city.

OAKLAND, CAL.—The suit of Alameda County against the Contra Costa Water Company for delinquent taxes amounting to $110,000 is to be reopened. This week District Attorney Walter Burpee is to take action to remove the injunction which the company secured some time ago.

SAN FRANCISCO, CAL.—The bid of the United States Cast-Iron Pipe & Foundry Company to the Board of Public Works for supplying pipe for the auxiliary fire system in this city is as follows: Pipe to be delivered on cars of a railroad connecting with a transcontinental line, $19.90, $24 and $20.65 a ton, for the different classes of pipe required; pipe to be delivered on a dock alongside of a deep-sea vessel, within reach of the tackle, $21, $25.10 and $21.75, and pipe to be delivered in San Francisco, $33, $37 and $33.75. Assistant Engineer Connick estimates the cost to be upward of $1,475,000. Thomas A. Lewis, representing Glasgow factories, protested to the Mayor and Board of Public Works for an extension of the time in which bids might be received, stating that he could underbid American houses, but it was decided not to delay proceedings any longer.

MODESTO, CAL.—Bonds for the extension of the present water system were carried at the recent municipal election of this city.

WASHINGTON, D. C.—Among the items in the sundry bill as passed by the Senate was $100,000 for the Presidio water supply.

COLTON, CAL.—A contract for about 9,000 feet of pipe for the city water system has been awarded to the Macy Manufacturing Company, of Los Angeles.

SAN FRANCISCO, CAL.—The finance committee of the Board of Supervisors has agreed to set aside $10,000 of the present bond issue for the proposed auxiliary water system.

LOS ANGELES, CAL.—J. H. McCabe, of Phoenix, Ariz., has purchased the entire stock of the Strawberry Park Water Company and announces that improvements in extension of service will begin at once.

SAN FRANCISCO, CAL.—N. H. Falk, of Arcata, Cal., is now in this city securing machinery and apparatus for the new water system and pumping station which is to be built in addition to the present system.

LOS ANGELES, CAL.—In the suit of the farmers of the Yucalpe watershed in San Bernardino county against the Yucalpe Land & Water Company, Judge Hutton decided in the farmers' favor, granting them the right to take 225 inches of water from the watershed.

ALAMEDA, CAL.—City Attorney Simpson has been instructed by the Board of Health to draw up an ordinance compelling the People's Water Company to supply that city with water from one well, instead of from the various sources, so that a pure water supply will be insured.

LOS ANGELES, CAL. — Contracts on bids have been awarded to Crane Company, of Los Angeles, for furnishing 16,000 pounds of pipe fittings, at $1,047.64 f. o. b. Los Angeles; to the Union Hardware & Metal Company for "T" and angle iron, at from $1.49 to $1.64 a hundred pounds, f. o. b Pittsburg.

REDLANDS, CAL. — Bids have been received by the Board of Directors of the West Redlands Water Company for pipe for a pipe line of approximately the following lengths and dimensions: 10,000 feet of 18-inch vitrified pipe, 1,000 feet of 18-inch steel pipe, 2,000 feet of 12-inch vitrified pipe.

HEMET, CAL.—The Moreno Irrigation Company has awarded a contract to Frank Kimball, of Los Angeles, for a pumping plant, which includes a 250-horsepower engine, triplex pump and air compressor. A contract has also been let to the Bapp-Gifford Company, of Los Angeles, for the laying of seven miles of pipe line on the company's lands.

SAN JUAN, CAL.—The Town Board has awarded contracts on bids for the laying of pipes for the water system to Brown & Chappell, of Hollister, for the laying of 3,000 feet of four-inch cast-iron pipe at 5 cents per foot; to M. Mackenzie for the laying of screwed pipe at $1\frac{1}{2}$ cents per foot, and for the laying of 10,200 feet of six-inch wood pipe at 1 1-3 cents per foot.

SAN FRANCISCO, CAL.—Chief Engineer Manson has received a communication from Secretary Garfield and Secretary Wilson, at Washington, D. C., granting permission for canal rights of way, two power houses, and the right to clear for the dam site at Lake Eleanor. The communication also stated that construction work could begin at once. Although Congress failed to confirm the grants at its recent session, the measures taken by the Departments of Interior and Agriculture are said to be as effective as if granted by Congress. The canal rights granted include the diversion canal from Cherry creek to Lake Eleanor; the canal from Lake Eleanor to the main canal, and the Tuolumne main canal. These canals will run in part through Yosemite Park, part through segregated lands attached to the forest reserve, and through the forest reserve itself. The exact sites which have been chosen for the two power houses has not been made public.

STOCKTON, CAL. — President John A. Britton, of the Stockton Water Company, announces that $30,000 is to be spent during the coming year in increasing the capacity of the plant and bettering the service. Two new wells are now being bored at Station No. 1, and two are being sunk at Station No. 2. A reinforced concrete building at the plant in the northwestern portion of the city to to be commenced on soon. New six-inch mains on San Joaquin street are now being laid, so that water can be furnished from either plant to patrons.

OIL.

SANTA BARBARA, CAL.—The Mayor and citizens of Santa Barbara have filed a protest with the Secretary of War against the Union Oil Company. The complaint is against a permit which the oil company desire to extend their pipe lines into the ocean near Santa Barbara. The citizens state that if this is granted it will ruin the beaches and thus injure the reputation of the city.

BAKERSFIELD, CAL.—Owing to the cost of living being advanced to 7½ cents per day, while their wages were increased to but 5 cents, some sixty or seventy of the employes of the Santa Fe's oil department at Midway left their jobs this week. The wages received by the men were $2.50 a day and board, and because their wages changed to $3.50 per day without board they were dissatisfied.

SAN FRANCISCO, CAL.—Owing to the fact that steps are being taken by Congress to abolish the present tariff on crude petroleum, the Mid-Continent Oil & Gas Producers' Association, of Tusla, Okla., has sent letters to all oil men, urging united action to prevent the removal of tariff.

BAKERSFIELD, CAL.—President L. P. St. Clair, of the Independent Oil Producers' Agency, says: "The present production of oil a little more than equals the present consumption. The surplus each day is approximately 6,000 barrels. There is less than six months' supply in the State on top of the ground."

BAKERSFIELD, CAL.—The Twenty-five Oil Company, at Midway, has let a contract to the Lacey Company, of Los Angeles, for the construction of 25,000-barrel steel storage tanks. A pipe system is to be installed to connect the various wells with the storage tanks.

ROSEMARY, CAL.—The Union Oil Company has reached a depth of 4,940 feet at its well here and is finding strong traces of petroleum of light gravity. Six and five-eighths casing is being used at this depth. Within but a hundred feet of this well is one that is producing oil at less than half this depth. This phenomenon cannot be accounted for.

FINANCIAL.

SAN FRANCISCO, CAL.—The California Stock & Oil Exchange, in its monthly statement of dividends paid by oil companies of California in February, reports the following: The Amalgamated Oil, $50,000; total, $950,000; Brookshire, $10,000—$352,500; Caribou, $20,175.75—$438,246.99; Euclid, $3,500—$78,500; Claremont, $4,500—$210,500; Columbia, $9,992.66—$184,863.62; Esperanza, $1,600—$25,450; Four, $3,000—$195,000; Junction, $2,500—$10,000; Kern River, $2,000—$98,000; Home, $2,000—$448,000; Illinois Crude, $2,000—$54,000; Linda Viata, $3,838.50—$38,585; Lucille, $2,670.40—$18,692.80; Peerless, $6,000—$759,000; Piedmont, $3,890—$15,207.30; Penal, $22,500—$662,341; Royalty, $800—$2,400; S. F. and McKittrick, $15,000—$120,000; Sauer Dough, $9,975—$359,100; Union, $117,711—$4,774,094.15; United Petroleum, $40,375.50—$1,654,078.43, and Wabash, $3,000—$84,000. The total dividends paid by the above companies in February amounted to $337,028.81.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer—who will listen with a willing and eager ear to the story of quality.
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Johns-Manville Co., H. W.

"George Cutter's Double Two"

INDEX TO ADVERTISEMENTS

BATTERIES

DRY BATTERIES

Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

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Stanley & Patterson, Inc., "Patterson."

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Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

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Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

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Tracy Engineering Company, Edge Moor."

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Bossert Electric Const. Co., "Bossert."
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Pass & Seymour.
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The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the **Journal of Electricity Power and Gas** *604 Mission Street, San Francisco.*

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.
Journal of Electricity, Power and Gas,
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AGENTS WANTED on a guaranteed weekly salary to represent our two publications, "Southern Engineer" and "Southern Machinery"; liberal terms for exclusive services; easy sellers; every engineer and every machinist is interested. Write at once. For further information, address W. R. SMITH PUB. CO., Sub. Dept. Atlanta, Georgia.

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POSITION WANTED by an experienced electrician with some business ability. First-class references on this Coast. Will accept low salary if opportunity for advancement. Address Box 102, **Journal of Electricity.**

FOR SALE at bargain prices: Two 6-wide, 9-high, 18 ft. Babcock & Wilcox wrought iron front boilers in first-class condition. For particulars, see B. W. RICE, 1419 Metropolis Bank Building, San Francisco.

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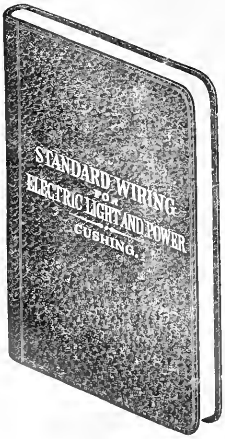

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General Electric Co., "G. E."
Sprague Electric Co., "Lundell."
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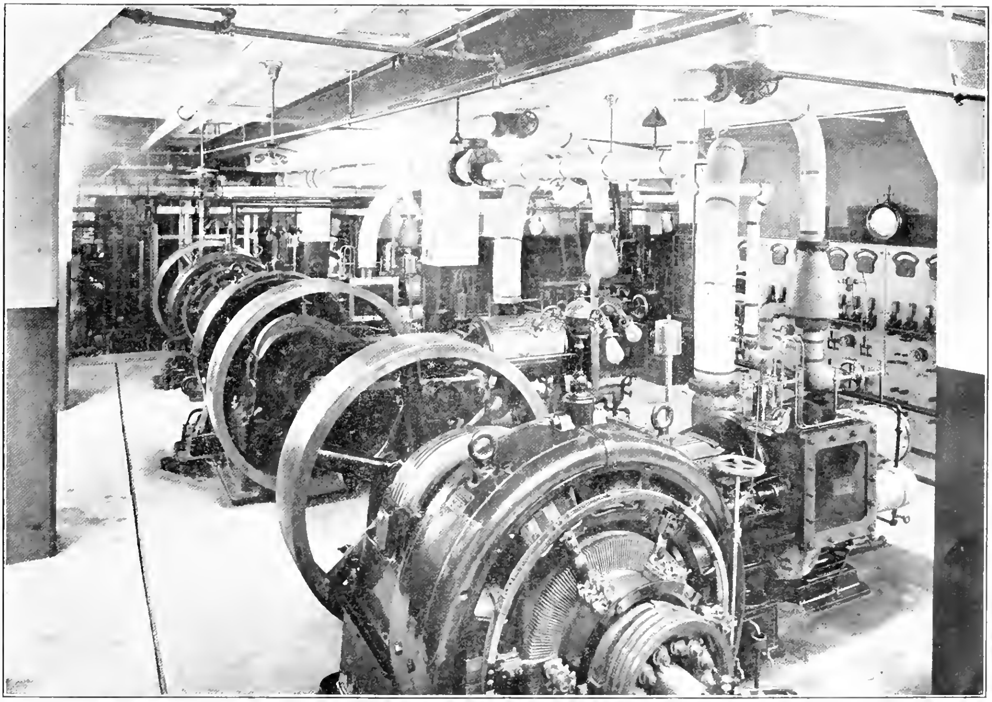
JOURNAL OF ELECTRICITY
POWER AND GAS
Devoted to the Conversion, Transmission and Distribution of Energy

VOLUME XXII. SAN FRANCISCO, MARCH 27, 1909 NUMBER 13

ISOLATED PLANT OF THE ALASKA COMMERCIAL BUILDING.

BY J. B. WILLIAMS.

The isolated steam electric plant of the Alaska Commercial Building, San Francisco, is illustrative of the high-class equipment necessary to supply the varied needs of a modern office building, the best types of which have been erected in the recent reconstruction of San Francisco. This plant supplies electric power for the elevator and lighting service of this and several adjacent buildings. Direct current is supplied by three three-wire generators. Steam is also furnished for heating, for the operation of the high-pressure fire fighting and water supply system and vacuum cleaning.

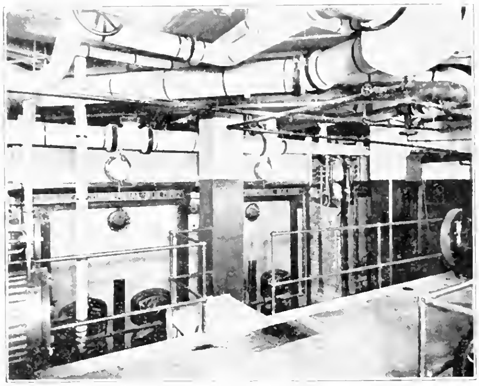


Engine and Dynamo Room, Alaska Commercial Building.

The steam boilers are of the water tube type, oil-fired from the rear, or what is known as back shot burner, with especially designed furnace for the purpose. The plant consists of three boilers arranged in a battery of two, and one single, rated at 150 h. p., each carrying a steam pressure of 140 pounds per square inch. They are equipped with two safety valves and two blow-off valves, and also automatic stop and check valves. The front and side walls are faced with a gray pressed brick such as are used on the face of the building, giving a very clean and neat appearance. The feed pumps are in duplicate and are of the steam-driven duplex type. The house pump used for pumping water for house service is also in duplicate and of same pattern with automatic control to maintain uniform water level in the tanks on the fourteenth story.

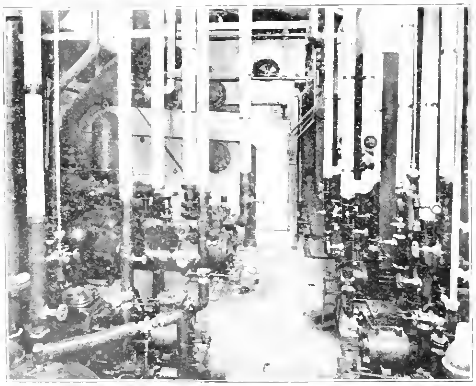
The vacuum pumps for the heating systems are also in duplicate and of the simplex type, each pump capable of taking care

of 50,000 feet of radiation. The fire pump is of special design and built according to specifications of the Board of Fire Underwriters. It is of 500 gallon per minute capacity at a pressure of 150 to 250 pounds per inch suction and is connected to a 30,000-gallon reservoir in the basement, into which all the tanks in the tank room can also be emptied, giving a total water supply available instantly of 60,000 gallons, independent of outside source.



Boilers of Alaska Commercial Plant.

The discharge of the fire pump is connected to the down pipe from the tanks on the fourteenth story, into which is inserted, close to the tank, a check valve, thus permitting the hose reel to be under pressure from the tanks at all times. When in case of fire the pump is put in service, the pressure would close check valve and subject the hose reels to the pressure and supply from the pumps. All the fire lines throughout the building are painted red, and red lights are kept constantly burning at the throttle valve of the fire pump, so that any one not familiar with the place could get the pump into service. All other valves being open and steam being at the throttle at all times, this can be accomplished very quickly by simply opening the throttle valve. In



Pump Room.

[illegible] ring a box located on each floor and [illegible] being allowed. Should he miss a box, [illegible] any cause whatever, a man is sent [illegible] to look him up, making the building doubly secure [illegible] or inside.

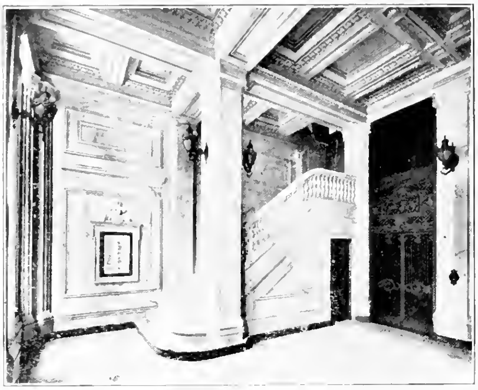
All the auxiliaries are electrically driven with chain drive, except the vacuum sweeping plant, which is steam-driven. The engine room floor is four feet above the boiler-room floor.

The engine foundations are built of reinforced concrete in one block 10 by 40 by 20 feet, entirely insulated from the main structure, eliminating possibility of vibration from this source. All wiring from the generators to the switchboard is conduited and cemented under the floors.

The engines are three in number, tandem compound, running at speed of 250 r. p. m., directly connected to three-wire direct-current generators, two being 100 k. w. and one 75 k. w. capacity. Steam is furnished the engines through an eight-inch main suspended to the ceiling with non-vibrating hanger and taken from the main through a five inch pipe, which is made into the sweep necessary to connect to the engine, presenting a very neat and symmetrical appearance.

All high-pressure drips from separators and steam mains are collected and taken to the high-pressure receiver and pumped direct through feed line to the boilers. Low drips are taken to a like receiver and discharged through the grease extractor and filter to the feed water heater, which is an open heater. All returns from the heating systems are delivered by vacuum pump to the feed water heater, making it necessary to use a very small quantity of make-up water.

The building consists of a steel frame with concrete fire proofing, faced with concrete curtain walls and floors. All indoor partitions are of steel studding and expanded metal lath covered



Entrance to Alaska Commercial Building.

with hard wall plaster. All doors and frames, windows, transoms—in fact, everything that is not of steel, iron or concrete—is covered with metal especially prepared to resist fire. Even the glass on all the frames, doors, rear and light well windows is ornamental wire glass. It is fourteen stories in height, the fourteenth story containing the tanks and overhead work of the elevators. The floors are of concrete, covered with battleship linoleum. The corridor floors are of marble tile, the wainscoting of highly polished and selected marble, which reaches to the top of the doors. All windows in the building excepting those in the light court are equipped with a sash hanger which will permit these windows not only to be raised in the ordinary way, but also allow them to be opened like a door, thus eliminating the dangerous necessity of outside cleaning. Each floor has ten offices, approximately 5000 feet, with soundproof as well as fireproof partitions. Two vaults are at the end of each corridor on every floor. Each office is entitled to a compartment which has a combination lock. These vaults are designed so as to remain intact through the worst vibration or conflagration.

Each office is supplied with hot and cold water, and filtered, sterilized and cooled water for drinking purposes.

Heating is accomplished by the vacuum system. All steam and return risers exposed in rooms are covered with regulation insulated cover. The radiators are of the wall type, being off

the floor, and anchored to the walls in a substantial manner, taking up a minimum of space, directly under the windows. Connections outside are provided with a duct with a regulator in order that fresh air may be drawn in, thus keeping the office ventilated without causing draughts.

All the plumbing is carried in shafts from top to the bottom of the building, and all water and waste branches, being but a few inches long, make everything accessible and easy of repair and dispense with the disagreeable feature of having the water pipes

Alaska Commercial Building, San Francisco.

buried in the walls. Heavy galvanized iron pipe and Durham fittings are used throughout.

Hot water is furnished by means of a complete circulating system through hot water heaters situated in the basement. The temperature is kept uniform by a thermostatic valve which is peculiar to the Tobey heater. Exhaust steam is used to heat the water. City water is furnished in cabinets, being first filtered through sand and gravel, then pumped to the house tank in the tank room on the fourteenth story, whence the various pumping stacks are fed. Water for sanitary purposes is obtained from an artesian well 200 feet deep. The water is delivered to the tank in the tank room by means of compressed air, which is pumped into the well by a horizontal 6x9 motor-driven compressor with chain drive. The efficiency of this installation compares very favorably with the direct steam-driven pump. A great advantage and convenience is apparent in that there are no moving parts in the well, dispensing with the necessity of pulling out the pump or bucket. All repairs are on the surface and easily looked after.

The discharge of the well is fitted with a by-pass, so that water can be delivered to a 30,000-gallon reservoir in the basement, which is always kept full for fire protection.

Sterilized drinking water is supplied by a system of forced circulation. Cold water is pumped through the building, the main being in the basement. Risers taken at the various shafts and collected in the main in the attic and carried to an expansion tank in the tankroom and from there returning by gravity to the cooling tank in the basement. As all branches are but a few inches long, there is no opportunity for any dead water to accumulate, making a minimum of waste and always insuring a good cool drink of water. The average temperature of the water in the offices is 42° Fahrenheit, 36° in the cooling tank and 45° Fahrenheit returning to the cooling tank, losing about 9° in transit. All cold water piping is covered with felt covering to prevent sweating as well as loss by radiation.

The cooling is accomplished by what is known as the compression system, liquid ammonia being directly expanded in coils which are submerged in the water to be cooled. This is known as direct expansion. The refrigerating plant consists of a motor-driven compressor with chain drive which has a capacity of three tons of ice per twenty-four hours.

Elevator service is furnished by three cars of traction type running at a speed of 550 feet per minute, 2750 pounds capacity. By test which was carefully conducted it was discovered that these elevators travel 2500 miles per month at a cost of 27 cents per mile, including repairs, interest, depreciation, taxes, insurance and operators' wages.

The building, which cost $850,000, was designed by Meyers & Ward and constructed by George A. Fuller Company for the Sloss and Gerstle interests of the Alaska Commercial Company.

TESTS IN ROCKY MOUNTAIN COALS.

Investigations conducted at the fuel-testing plant of the United States Geological Survey at Denver, Colo., during the fiscal year 1908, into the washing and coking of the coals of the Rocky Mountain region have just been reported upon by the survey. In the time that the plant has been in operation, results have been achieved which will prove of the greatest importance to the entire western part of the country.

Of thirty-seven coals tested from the Rocky Mountain region, all but three produced good coke under proper treatment, though a number of them had been considered non-coking. A bulletin detailing the tests conducted at the Denver plant by A. W. Belden, G. R. Delamater and J. W. Groves has just been issued by the Technologic Branch of the Geological Survey.

"The tests detailed in this bulletin are a continuation of the work started several years ago in St. Louis at the Government fuel testing plant there. On the completion of the work at St. Louis the writer made a trip through the Rocky Mountain region for the purpose of selecting a site for washing and coking tests on coals of the western half of the United States, with the hope of getting into closer touch with the fields from which little or no coal had been received at the testing plant in St. Louis.

"The different points available were visited, and after investigation, Denver, Colo., was selected as the most suitable on account of its central location and railroad facilities."

LIGHTING WITH METALLIC FILAMENT LAMPS.

Discussion by members of the San Francisco Section, American Institute of Electrical Engineers of paper read by Mr. E. I. Sherwood and published in the Journal of Electricity, Power and Gas, of March 20, 1909. The following took part in the discussion:

A. H. Babcock, Electrical Engineer Southern Pacific Company, Chairman.

C. L. Cory, Professor of Electrical Engineering, University of California.

S. G. McMeen, Chief Engineer Empire Construction Company, San Francisco.

G. E. C. Holberton, Pacific Gas & Electric Company.

H. Y. Hall Jr., Assistant Electrical Engineer, Southern Pacific Company.

R. M. Alvord, Sales Engineer General Electric Company, San Francisco.

S. J. Lisberger, Electrical Engineer, California Gas & Electric Corporation.

S. B. Charters, Leland Stanford Jr. University.

C. J. Wilson.

The Chairman: Gentlemen, I am sure we have all been very interested in this paper. The only regret is that advance copies were not sent out, so that they could be thoroughly digested and an adequate discussion brought out. Those curves are full of meat, and I think would bear a pretty careful analysis. There is a certain conservatism to be met in the introduction of all new devices and particularly so in the incandescent lamp business. The lighting of our homes and office buildings—the places that we live in and the places we work in—according to my notion, has been extremely bad. I have been very much interested in reading the papers and the discussions of the Illuminating Engineering Society as showing the results which can be reached when men with brains begin to use those brains in a certain definite direction. Their efforts are directed in the first place to the right use of the light in regard to its effect upon the optic nerves, to take care that we do not have reflections, and that the light comes in the proper direction. In the second place, they are directing their efforts toward economy in cost per year in operating the lamps. Both of those are very important things. The architects of today seem to hang back and cling to the old methods that were used when we had kerosene lamps, and afterwards, when we had gas. I am expecting that the scientific men who are working along these lines will produce some important revolutions. Papers of this kind are valuable to us who are not accustomed to dealing with these things in a technical manner. We have no formal discussion, because those who were to take part have been held up by the washouts and have not been able to get through in time. I will ask Professor Cory if he will open the discussion by some appropriate remarks.

C. L. Cory: There was one important point touched upon in the paper this evening, regarding the transformation of energy in a lamp and its use for the production of light or illumination. The lamp which is used for conversion of a small per cent of the energy of water power into light is really at the extreme, or at the top of the pyramid. On the other hand, if we consider that our electrical energy is coming from fuel, the device for converting the heat energy or energy of the furnace—perhaps the steam engine, or turbine—is at the other extreme. Therefore, from the standpoint of possible economy the development of an efficient light—that is, an efficient device for converting the [illegible] energy into light be given the most serious consideration [illegible] engineers. That is one point which is very apparent [illegible] metal lamps, there is something which has [illegible] development of light, and that is [illegible] illumination is inherently connected with [illegible] reason why we have such a high efficiency [illegible] excessive high temperature of [illegible]. On the other hand, in the incandescent lamp [illegible] temperature is much less, and also the efficiency.

One thing that I noticed in our rather hasty view of the slides was the difference in efficiency between the small and the large tungsten lamps. As you of course know, the successful smaller lamps have come after the development of the larger lamp. There can be no question as to the very large application of the incandescent lamp even in the future. Nevertheless, it is striking when you go into a building where there are carbon incandescent lamps and tungsten lamps side by side, to notice the difference in the color of the light. That, of course, is due to the difference in the temperature of the filament.

From the standpoint of the power company or the company furnishing the light—rather, furnishing electricity, because that is what it amounts to—there is a problem involved which is of some considerable consequence, because there is a tendency right along to increase the voltage of our lamps from the old fifty-volt type to one hundred and ten and two hundred and twenty volt types of today, and now we come seemingly to a step backwards in the voltage supplied at the base of the filaments.

There is one very fortunate thing about the introduction of the tungsten lamp at this time. It is not like sudden changes in other fields of electrical engineering. If you decide, for instance, on some large single phase railway system that a certain frequency is to be used, it is a very expensive proposition to change the frequency; it will be found to cost a great deal to change all the machinery connected with that installation. On the other hand, it is not necessarily expensive to give the tungsten lamp a very complete trial. In this connection I think of one problem that has been occupying Mr. Vincent and myself for some little time: It is the choice of the kind of lamp, voltage of supply, etc., which is proper to put into a building containing the equivalent of about five thousand 16-candlepower carbon lamps. The illumination here is to be that of a library. The general illumination is to be taken care of and at the same time the individual lights, such as might be used in a library. The two systems which might be considered would be the 220 volt, 16-candlepower carbon lamp throughout, varying the size of the lamps and the number of lamps in a cluster, and all that sort of thing, which would be most desirable not only regarding the number of lights, but the kind of illumination—a very different kind of illumination in the large reading room than in a small room, where but few individuals need the light at one time.

I think electrical men have noted that our gas friends have advanced, perhaps up to within the time of the metal lamps, a little more rapidly than the electrical engineers, in new systems of lighting, especially in the very efficient methods of making gas burners for special purposes, and in the color of light. Five thousand lights is not a very large number, and yet it is an instance worthy of consideration in that while the number of lights will be very greatly reduced for a given amount of illumination with the tungsten lamps, and also the number of outlets and the size of control boards, cabinets, and so on, yet when we have gone through the thing pretty carefully we find there is a very material saving in the actual cost of installing the necessary wiring, if we use the tungsten lamps instead of the carbon incandescent lamps. I do not know if it will be sufficient to meet the difference in first cost of the lamps, but there will be a very large saving in using the 110-volt tungstens instead of 220-volt carbon lamps.

There may not be so much saving in the wiring, but in the general arrangement and the number of outlets required to conform with the requirements of the underwriters. Again, even when we come to the final adoption of the tungsten lamp, it is worth one's while to consider the size of thee tungsten lamps you are going to use in each case. As far as the carbon incandescent lamps are concerned, there has been a wonderful development in clusters and different kinds of globes, producing more uniform distribution, and I think even after we have come to the adoption of the tungsten lamp, or any of the metal lamps, we have got then to begin to investigate which is the best size to use for certain conditions. Naturally, for residences there is perhaps nothing that would be more acceptable than the smallest tungsten lamp we can get; I think it is known as the No. 15, or 20-candlepower, and that is the lamp which we would likely substitute for our 16-candlepower carbon lamp.

One other thing which I want to say, and that is that you find some skepticism in the ordinary users of light toward the tungsten lamp. I was surprised the other day in sitting at table with a half a dozen men, who should know better, to hear them declare that in fact there was no saving in meter bills using metal filament lamps. When you tell them that carbon lamps that cost 20 cents should be replaced by a tungsten lamp the first cost of which is five to six times as great, they begin to think that it is merely a scheme of the manufacturers to have them buy new lamps. As I say, there is a skepticism, which I dare say will be overcome in time, but to those of us who are giving serious attention to high efficiency, electricity to light, the saving of more than 50 per cent in the consumption of energy to produce a given candle power of light means a very great saving in the cost of operation. The saving will come in less cost of fuel, and in smaller generators, transmission lines, and transformers, and it is worth while giving special consideration to the change in type of lamps.

We are indebted, I am sure, to the author of the paper for these curves. I should like to have an opportunity to study them more carefully. There is a good deal of material collected here in definite form, and it would be very valuable for us who are interested in the use of the tantalum or tungsten lamp, to get some of the data shown by these curves, or even the tables themselves.

The Chairman: There was one point touched on very briefly, i. e., the cost of installation as compared with 16-candlepower carbon lamps and the tungsten or metal lamps, which seems to me would stand some amplification. The first cost of any installation is of some importance; but according to my notion the cost of operation of that installation is very vital. It is what we pay for year after year, and when a 10 per cent saving was spoken of in the cost of illumination there came to my mind an instance which has just gone through my office, where a building that contained a very large waiting room that was to be lit, according to the architect's plans, by 200-volt, 16-candlepower lamps. With electricity at a cost of three cents a killowatt hour, tungsten lamps made an annual saving of $3,800 in the lighting of that building. Strange to say, the report on that installation was criticised very severely on the ground that the tungsten lamp is an experiment, they did not think it would amount to much, and probably for a year or two we had better stick to the old carbon lamps. That is one of the conservatisms I alluded to.

Right here is coming a problem touched upon by Professor Cory, the problem of the distributing system. It is very much to the economy of the power company to use the 200-volt distribution, especially when they can supply a large service from one transformer. The cost of copper runs down very materially. They do not like very much to change to 100-volt, especially since it runs down the meter bill. On the other hand, the public has something to say in the long run, and that is a problem and condition that has to be met. It is not one to be shied at, dodged or evaded, and inasmuch as the organization whose guests we are tonight is foremost in the use of the 200-volt distribution service I would like very much to hear from someone connected with that institution on that subject. If Mr. Holberton is present I would like to hear from him.

George E. C. Holberton: I can only repeat what Mr. Babcock has said. We have got to go up against the public, and we propose to do it. The question of a 200-volt system is not altogether one of economy, pure and simple. There are other features aside from that, not only to the company but to the consumer. I assume that Mr. Babcock refers particularly to Oakland and Berkeley and that territory, because that is the territory where we are operating that way, and have now for about nine years. That started in the summer of 1900, and the problem then was this: At that time Oakland had a service, the most of which was 52 volts, with practically individual transformers. It was a bad service, poor regulation, and an uneconomical service to operate. Outside of the business district there was only the Jackson street district and Piedmont, where the wealthier class lived, that were using electric light. The houses in the vicinity of that district were old houses, which were not wired, and the growth of electric lighting supply would not come in that territory at all, because of the great expense of wiring the old houses. But we did have a problem to supply electric lights to new territory, where the buildings were much scattered. Taking the matter up at that time the company could not see its way clear to supply that territory by the method used down town, that is, 52 volts, nor even by changing to 100 volts. Then the question came up, that we wanted business and we wanted to accommodate those people in the growing residence territory, where the density was very light; that is to say, where the number of lamps used per block or lineal foot was small. But how was this to be done? We began then to figure on the question of using 200 volts, but even the ordinary 200 volts, 2-wire system, would not pay. Either the consumer would have to pay a heavy tax for extension of the line in order to supply him and have the company get any kind of a just return on the investment, or we would have to charge a rate which would be prohibitive. To overcome these difficulties we thought of the scheme of using 440 volts on the outside of a 3-wire network. That brought the cost of original extensions down so that we could make extensions without any cost to the consumer and supply practically all of the territory which was then building up and which has since become a very large territory. I do not know of any place where the business has spread as much as it has in Oakland and Berkeley. For about you might say eight years—seven or eight years—the Oakland Gas, Light and Heat Company did extend in that way without any charge to the consumer, and I feel perfectly safe in saying that if we had not that system, we could not have done it. Some time ago, I think as much as five years, I read a paper and gave some of the figures as to the relative cost of supplying the ordinary residence lighting by 100 volts, and by 200 volts, 3-wire, and by our 440-volt system. At that time we never dreamed of the advent of the tungsten lamp, and even then the carbon filament lamp, 220-volt, was nothing compared with what it is now. The objection raised then was that if the people took 220-volt they had to pay more for their lamps. That was met by the company's charging the same price for the 200-volt lamps as for the 100-volt lamps. That was done at a loss, but it was thought to be good policy. Then we had trouble with the wiring concerns. They claimed that the apparatus required by the Board of Fire Underwriters could not be purchased locally and that condition had to be met, which we did by establishing a sort of supply house in our office at Thirteenth and Clay streets, where we carried a stock of material which would be passed by the underwriters for that voltage. Now that the tungsten lamp has come, we have got to meet that. Just how it is to be done I am not prepared to say, although I have been assured by one of the largest manufacturers that they have now produced a 220-volt lamp that is satisfactory; and I do not think that we should make any change until it is determined whether that is going to be a fact or not. The lamps are not on the market and are not sold. The same company tells me that they can produce and will sell at the present time the tantalum for 220 volts. Now, if the light and efficiency of the tantalum lamp is approximately the same as the tungsten, I think that the problem can be solved in that way.

I do not know as there is anything else that you care to have discussed or to hear about. If there is anybody who would like to ask a question I will be pleased to answer.

I will say this, that naturally the largest demand for the tungsten lamps has been in the heavier installations, where the saving in dollars and cents is very much greater; and the heavy consumption naturally comes in the business district. In all places where we have the 220—440 volt system, as the consumption grows—that is, the density of consumption, the number of lights for installation—we have extended our 200-volt, 3-wire system, and we will keep on doing that. The 440-volt system was essentially a pioneering sort of system. It was a means by which we could reach everybody without any charge to the consumer.

The Chairman. The use of the 200-volt tungsten lamp combined with the 3 wire system would certainly be a very great step ahead, and we shall hope for the best on that.

George E. C. Holberton. In my remarks I referred to American production; I understand that in Europe and England the 220-volt tungsten lamp is already a commercial article in use.

The Chairman: I hope we shall find the domestic manufacturers equal to the foreigners.

George E. C. Holberton. The foreign lamp can be purchased now. I feel sure that the 220-volt tungsten will be produced, just as the tantalum is. I would like to say, too, because I learned that a number of people assumed that our company was one of a few who were in the 220-volt business, that we are not the pioneers in this. I think that Providence, R. I., is the first company to use it to any great extent. They have had for about eleven years a system of distribution at 500 volts, 250 volts between the neutral and the outside. That is an ideal system in other ways. A great many companies, through originally the introduction of the 500-volt trolley roads, have begun to supply 500-volt meters. That in the first instance is taken from the trolley. That is objectionable from a good many standpoints, particularly the insurance. But they have the service installed and they went to the 500-volt metallic service just as we did in Oakland. There are other 3 wire, 440 or greater voltage installations in Dallas, Texas, I recall as one; Richmond, Va., is another; St. Louis, and then there are smaller installations, to the number probably of 75 or 100 that I have looked up, just to see how common it was—that is, in the United States. In Europe and England it is very common, and I believe that the very fact that the saving to the company is so great in that form of distribution, and the ability of the company to reach a so much greater area at the same price for current, will induce the manufacturer to endeavor to meet that condition in his lamp. I do not recall the exact figures, but the production of 220-volt lamps has increased enormously in proportion to the total production.

The Chairman. During the reading of the paper, when the slides of the different parts of the lamp were on the wall, a little ancient history in the lamp manufacturing art came to my recollection, and inasmuch as the man who was responsible for the invention is not at all known in connection with it, and for the reason that the invention is so generally used, I would like to take your time for a few minutes and tell you of the invention of the Stereopticon Lamp. About ten or eleven years ago Professor Burkhalter, of the Chabot University, asked me if it was not possible to get an incandescent lamp that would give him a mere point of light so that for stereopticon work he could be independent of the arc light, which he could not get in his lecture room, and use an incandescent lamp, which he could get. His idea was beautifully simple. If he could get a point of light and put it in the focus of the condenser he could secure even illumination without any shadows. The ordinary lamp that we used then cast shadows from one turn of the filament over the other, and it interfered with some of his stereopticon pictures. He wanted a disc of light as small as possible. A small, flat coil in the shape of a disc or a cone-shaped filament was what he had in mind. I then was in the local office of the General Electric Company, and immediately wrote the lamp factory and sent on sketches of a number of his ideas. There was a most astonishing lack of comprehension on the part of the lamp factory. They took it up with great reluctance. It took a long period of correspondence. When the first lamps came out they were hopelessly wrong. We argued the matter at great length. Finally, as a last resort I asked the lamp factory to send me the diameter and length of the filament required for a given candle power lamp. On getting this information I went into the stock room and picked out a fuse wire of the size of the filament they had specified; then went over to Mr. Burkhalter's shop, and with his assistance turned up a wooden cone, the angle of the faces being practically the angle of the cone of rays from the focus to the lamp. We then wound the right length of fuse wire up on this cone in identically the form that is used today in the stereopticon lamp, packed the little cone and the fuse wire on it in cotton, and sent them on to the lamp factory. Inside of a few weeks they had bulletins out on the new headlight and stereopticon lamps. Mr. Burkhalter, the real inventor, has never received the proper credit, although it was really his personal invention.

We have here tonight a gentleman who has had a great deal of experience in incandescent lights of a certain kind—the lamps that wink when the telephone is pulled down—and I will ask Mr. McMeen if he will give us some of his personal experience in regard to the telephone lamp.

S. G. McMeen: The lamps to which Mr. Babcock refers are those which are associated with telephone lines and telephone cord circuits in the very widely used manual common battery switchboard system. They are interesting from the lamp point of view because they are very small, representing a special phase of lamp manufacture, and because the making of them is a large industry. Several millions of such lamps are in daily use.

The problem which these lamps represent is not one for the illuminating engineer, but is more closely allied to the electric sign industry, as the lamps are used solely for signal purposes. The usual practice is to mount each such lamp behind a slightly opalescent lens. The dispersion of rays enables the signal to be a very pronounced and clearly defined one, though the lamp has a diameter of only about a quarter of an inch.

In the earlier applications of these little lamps a great many troubles were experienced. They arose principally from the fact that, because the lamp is so small, the ratio between the space occupied by the filament and the total space exhausted made the getting of a sufficient vacuum rather hard. Another difficulty was the very low voltages on which the first lamps had to burn. These were usually four or eight volts, which made the filament rather short, and on account of the small current allowed the filament was very much more delicate than its support. Furthermore, the lamps are used for two purposes, the greater number of them being mounted with relation to the lines, as calling signals, and a smaller number being mounted with relation to the connecting cords, as supervisory signals. These latter lamps stand in a keyboard upon which the connecting plugs are dropped as they are taken out of service, in sockets in which the plugs run back when so dropped. The amount of jar so occurring in regular practice was sufficient to run the breakage of filaments in these keyboard lamps up to an excessive amount; and at one time in the early days, orders actually were issued to operators to restore plugs carefully by hand to their keyboard places on taking down a connection.

To place so great a burden on operating as a mere result of using lamps not hardy enough was plainly a thing not to be permitted. The natural solution of the problem came about by improving the type of lamps manufactured and by changing the electrical conditions under which the system operated. Greater skill was gained in making the lamps; the processes of exhaustion were improved; the voltage was raised to about twenty-five, at the same time simplifying the whole scheme of circuits; and the lengthening of the filament gave it elasticity enough to decrease the breakage to a reasonable amount.

Interesting experiences were gained during these efforts, and an amusing one occurs to me. The filaments of the little lamps were made by the cellulose process, filter paper being dissolved in a solution of a caustic alkali in water. This cellulose "syrup" was squirted into a rotating jar of alcohol, which dissolved the water and alkali and condensed the cellulose into a thread. The alcohol was recovered for further use by distillation, so as to leave the water and alkali behind. The process went on very nicely until the Federal Government stepped in to stop the running of an illicit still. A distiller's license had to be taken out before the manufacture could continue.

Relative to lamps in general, as energy translating devices, I am reminded of an amusing situation which rearises each year in a certain university. Each of a considerable number of students is given a jar containing a known weight of water, together with an incandescent lamp, a source of current, a volt-

meter, an ammeter, a thermometer, and a watch. He causes the lamp to burn while immersed in the water, and observes time, rise of temperature, current and potential.

After repeated trials each student admits his inability to account for more than 96 or 97 per cent of the energy absorbed, and the expression on his face is a study when he discovers that what he is calling a loss of 3 or 4 per cent really has escaped the observation of his instruments because it was emitted as light.

It is well, in considering metallic filament lamps, not to be misled by the ratio between the blackening of the bulb and the falling off in candle power. It is evident that the metallic filament lamp is much superior in this regard and that the blackening of the glass does not indicate anywhere near the same degree of lowering of light. It is well not to be too sure that we have reached the final solution of incandescent lamp practice and to keep in mind the thought suggested by Steinmetz as to the possible discovery of an allotropic form of carbon which may restore that element to a useful position in the art. One of the wise men of our time, Mr. Robert Kennedy Duncan, has said that radical developments in an art come in two general ways—along the border line between two sciences or by pushing known phenomena to their limits. The development of the metallic filament lamp illustrates very prettily both of these thoughts. The production of the materials themselves is on the border line between two sciences; the use of the material represents a case of extreme localized high temperature.

The Chairman: I am sure we have all been very much interested in these telephone experiences. Is there anyone here who can add anything to the history of the incandescent lamp art—any kinks or ideas that you have?

H. Y. Hall Jr.: There is a point I would like to see brought out, and that is the reduced effective life of the tantalum lamp when used on an alternating current circuit. Mr. Holberton's statement that it might be possible to use tantalum or tungsten lamps on his 200-volt circuit brought to my mind a recollection of seeing somewhere the statement that the tantalum lamp was unsuited for alternating current on account of the effect of alternating currents on the filament; it seems to break up or disintegrate the filament; and that the life is very much shortened on the alternating current circuits I take it that all the curves and data given tonight and the comparisons were made with direct current, and not alternating. I would like to ask Mr. Alvord what the effect is.

R. M. Alvord: Just exactly what that effect is I cannot say. The life is somewhat shorter on the alternating than on the direct current; the last figure I think was something like two-thirds of the number of hours. I would be very glad to have Mr. Sherwood confirm that, and I will give you the definite figures if you desire.

C. L. Cory: One point that has been touched upon—I mentioned it very briefly—is the very great difference in the quality of the light. Those who have used the tungsten lamp for reading or doing any work exacting on the eye have noted that the light is much whiter than that from the carbon lamp There is not only the advantage of higher economy, but also improved quality.

One thing shown by those curves is the large current when the metal lamp is first thrown in, during the first fraction of a second as shown by the oscillograph. Of course, the increase of resistance in the metal lamp filament with increased temperature is just the opposite from the change in the resistance of the carbon lamp.

The Chairman: Mr. Holberton, could you not cast some light on that tantalum filament question?

G. E. C. Holberton: In taking up the matter of overcoming the objection to the 200 volts we took up the use of the tantalum lamps, and on the basis of getting from 800 to 900 hours actual time from the tungsten lamp, the manufacturers told us that we could count on 600 hours in the use of tantalum lamps in alternating current.

H. Y. Hall Jr.: It would not make so much difference in the case of the carbon lamp.

G. E. C. Holberton: That light is very much the same as the tungsten. You have got to try that on the basis of a 3½-watt lamp. So that for residence lighting, where rates are highest, naturally the saving is considerable; and in heavier districts, where the lighting is dense, the difficulty is overcome by the use of 100-volt lamps

S. J. Lisberger: When I was at the Stanley factory they were working on a small transformer for use with a low voltage, 25 volts, lamps. That was a very neat device, very small. They did not have any figures on the cost or efficiency of that. I would like to know if Mr. Alvord can supply anything on that.

R. M. Alvord. We have not been supplied with the cost of those concentrators. They are trying them out in the East, and a number of the engineers from Schenectady were at work on them. They were very much interested in it The compensator is 2½ inches in diameter; it is a little globe that fits under the socket, and the men who have been experimenting with those tell us that the results to be obtained from the light and efficiency from the voltage of 27 volts is remarkable in the tungsten lamp We are hardly in a position to give you the data on that until they have given it a fair trial

The Chairman: Is there anyone present that has had any experience in testing incandescent lamps after they are turned out of the factory. I would like to ask for some information for my own use because I have been receiving lately some inspection reports on lamp tests made at the factory and I must say that it shows an astonishing lot of poor lamps, the rejections in some cases on ordinary specifications—that is, what are called the maker's standard specifications—the rejections have been as high as total, other lots 80 per cent, other lots 50 per cent; and at that I mean 50 per cent of several thousand lamps tested. To me it was astonishing, and I would like to know if any other user of lamps has had any similar experience.

S. B. Charters: Carbon lamps, do you mean?

The Chairman: These are carbon lamps entirely.

S. B. Charters: Any special voltage?

The Chairman: No, scattered You can readily understand that the lamps used by the Harriman Railway and Steamship lines cover a wide range

S. B. Charters: I may be able to give you some information on that. I have just completed a series of tests on five different makes of lamp. The number was rather small, only six of each. They were tested for initial candle power and also for light, for 600 hours. As I said, there were five different makes. Four sets were of 110-volts and one set was of different voltage. In no case did the average come to 16-candlepower The lowest set gave an initial candle power of 13.25 They were burned through the 600 hours. They were calebrated over 60.) hours and showed a gradual decrease. The lamps all went down, but all remained above the 8 per cent of the normal rate One standard developed slightly better than 11-candlepower The best lamp developed a trifle better than 13-candlepower. In almost all there was a noticeable blackening, and in a number of the poor ones they showed a red discoloration I doubt that from so small a number as six you could form a fair judgment; but the lamps would show fairly well, as the individual lamps of the same maker would not vary very largely That is the experience we have had with five makes.

Mr. Babcock: Our annual lamp purchases for all the lines will run to nearly 300,000. Of course, that is not large as compared with central station requirements, but is large enough to come to a pretty fair average as to quality, and I had hoped to get some corroboration or discussion on that point

C. J. Wilson: I think you have omitted something very important. We have not heard anything about the Nernst lamps. I think the Nernst lamp has an efficiency nearly that of the tungsten lamp The representative on this Coast will guarantee a replacement or maintenance charge of 5 mills per kilowatt hour. I would like to hear from somebody on that.

The Chairman: Is there anyone present who can say a good word for the Nernst lamps?

[illegible] excellent spectrum [illegible] no particular preference [illegible]

[illegible]

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS' ANNIVERSARY DINNER.

The American Institute of Electrical Engineers celebrated its Silver Anniversary in a dinner at the Hotel Astor, New York City, March 11th. The celebration was made the occasion for attempting various new electrical effects. The large [illegible] room was set as an actual scene in Venice, the guests looking through an open balcony at one end across the Grand Canal and the Doge's Palace. At the other end was a view of the Rialto, seen through palms and shrubbery. In each of the windows was set a transparency showing some view in Old Venice, while the large drop pieces were so illuminated as to give the effect of a moonlight night. At the [illegible] of the speaker's table were two large American flags [illegible] by an eagle and all the stars in the flag were illuminated each with an individual tungsten lamp of full candle [illegible]. In the open balcony around the hall dense masses [illegible] and flowing plants were placed, with Cooper Hewitt [illegible] lamps behind them, giving the effect of early spring sunshine. On each table, instead of the customary flickering [illegible] and [illegible] the wiring of each of the fifty tables [illegible] standards, there were used small silver vases, in each vase was a small storage battery, to which [illegible] miniature lamps. Over these was placed [illegible] glass [illegible] a block of ice, through which [illegible] roses in water; so that [illegible] upward through the glass to [illegible] softened effect. Every table was thus illuminated without any obstruction of view or any [illegible]. Outside the hall was a huge [illegible] of the institute wired with [illegible] incandescent lamps, and inside the room, over the speaker's table, was another sign, having the badge as a [illegible] and the words "Silver Anniversary" picked out [illegible] small tungsten lamps. All these novel effects were most successful. President [illegible] of the Institute, was chairman and toastmaster, and his opening remarks dealt with [illegible] of the Society. Cable messages of congratulation [illegible] electrical societies of England, [illegible] and telegrams of good wishes were received from Professor Alexander Graham Bell in Nova Scotia, Charles F. [illegible] in Cleveland and Thomas A. Edison [illegible] Florida. [illegible] of the Sister Societies were offered [illegible] President [illegible] M. Smith, of the American Society of [illegible] Engineers. The toast of Charter Members was [illegible] Professor Elihu Thomson, to whom, with [illegible] a diploma of thanks and [illegible] in recognition of the work of [illegible]. Mr. [illegible] made a brilliant speech on behalf of the past presidents, of whom no fewer than nineteen [illegible] "elder statesmen" had formed a separate organization whose services were at the command of the Society for consolidation or for any other [illegible] that might be assigned to it. At the end of his remarks he presented a massive silver loving cup in the name [illegible] of the past presidents now living to Mr. T. Com[illegible] surviving past president. President [illegible] Stevens Institute of Technology made [illegible] Engineering as a Profession, and on the [illegible] of their duties as citizens by electrical [illegible] in the formation of correct public [illegible] the fads and fancies of theoretical economists and [illegible]. The dinner was brought [illegible] "Auld Lang Syne," as a solo. Mr. A. F. [illegible] the English expert [illegible] under whose splendid leadership [illegible] in the chorus. During the dinner President [illegible] stated that the Institute had [illegible] members [illegible] the present month with [illegible], not [illegible] students in university branches. Over [illegible] branches were represented at the dinner, [illegible] San Francisco and Austin, Texas.

HEAT DISTRIBUTION OF AN OIL GAS WORKS AND GAS ENGINE.

BY J. C. H. STUTT.

The reasons for this discussion before th[illegible] was to determine why the large gas engine units [illegible] successfully compete with the steam engine on the Pacific Coast where crude oil is used for both making illuminating gas and generating steam, and we believe this subject will be of interest to other readers, and we invite a discussion and criticism in the friendly spirit that this is offered.

In the manufacture of illuminating gas from crude oil it requires in general practice from 9 to 10 gallons of oil to make each 1,000 cubic feet of gas, and averaging the oil as obtained here, coming mixed from many different wells, at 8 pounds per gallon, we would have at the best practice [illegible] or 72 pounds, as required to make 1,000 cubic feet of gas, and average crude oil will show 18,500 B. T. U. per pound, so we would have

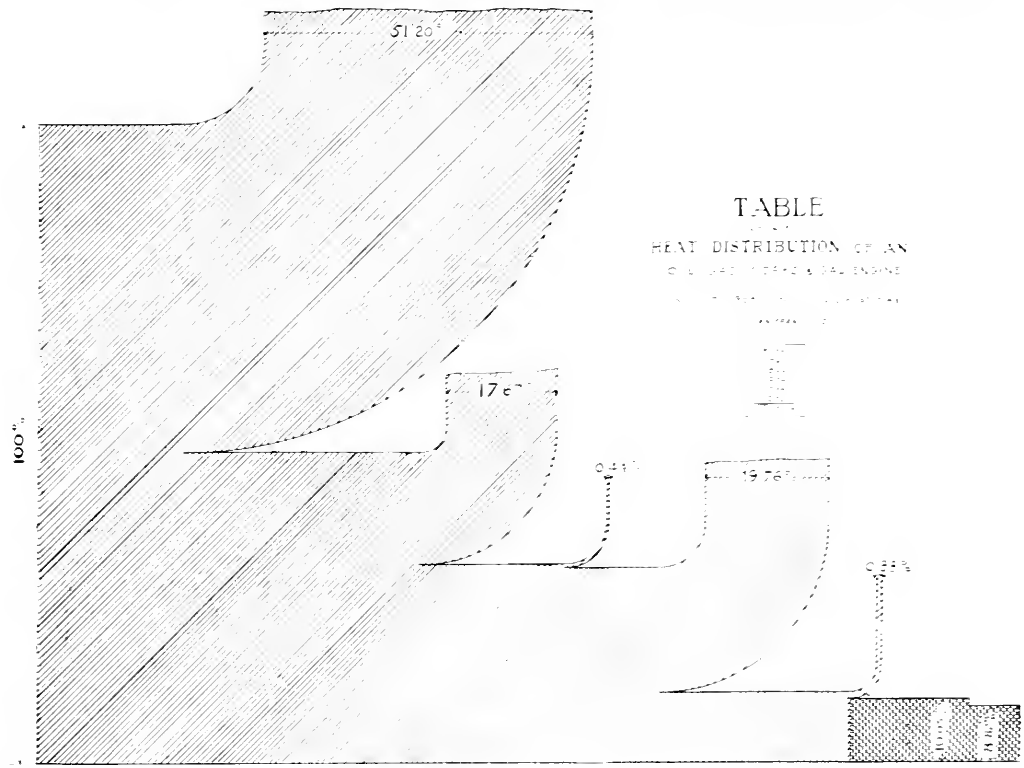
B. T. U. [illegible] water required, or 17.76% of 1,332,000 B. T. U.

The [illegible] average [illegible] 4% of 57 h. p. or 2.28 [illegible] 2.28 h. p. expressed in B. T. U. [illegible] 2.28×60×33,000 [illegible] 775, or 5,825 B. T. U. or .44% of 1,332,000 B. T. U.

[illegible]

T[illegible] 408,520 B. T. U. [illegible] exhaust, radi[illegible] mechanical efficiency [illegible] 57 [illegible] 775, or 145,626 B. T. U. or 10.9 [illegible]

[illegible] 57 h. p. or 4.56 [illegible] is expressed by



72×18,500 = 1,332,000 [illegible] of gas.

[illegible] B. T. U. [illegible] 1,332,000 [illegible] equals 682,000 [illegible] 51.2 [illegible]

From [illegible] gas engines [illegible] at maximum [illegible] cubic feet [illegible]

As [illegible] per horse [illegible] and 57 [illegible] the [illegible] or a difference of 45% [illegible]

[illegible]

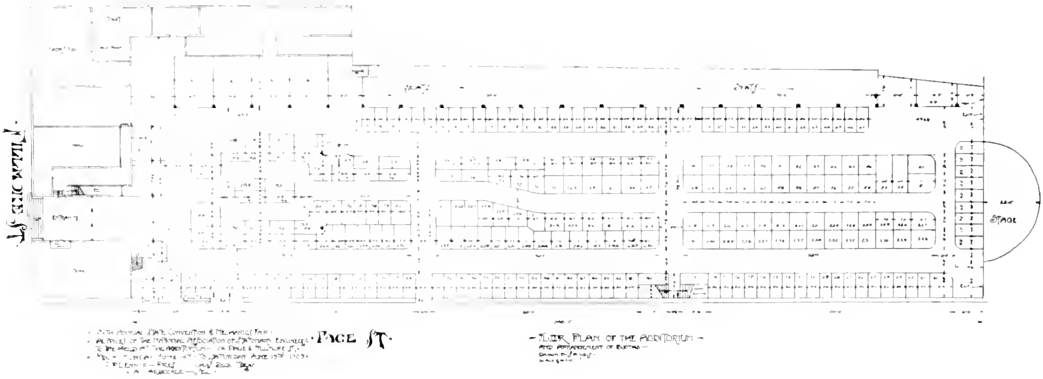
NATIONAL ASSOCIATION OF STATIONARY ENGINEERS' CONVENTION EXHIBITION.

The National Association of Stationary Engineers will hold its Sixth Annual State Convention for one week in the Auditorium Pavilion, corner Page and Fillmore streets, from June 14th to June 19th, 1909. In connection with the convention an interesting feature will be the exhibition of machinery and electric appliances, provided by the business firms of San Francisco and vicinity.

P. L. Ennor

A. C. Arbuckle

The National Association of Stationary Engineers was organized in 1882 for educational purposes, and for the uplifting and promotion of steam engineering as a profession. Its work has enlisted the support and encouragement of the manufacturers and power plant owners throughout the country. The organization has expanded and now has branches in every part of the United States and Canada.



In this exhibit, however, they intend to cater to the machinery and mechanical specialty people, with a view of making it especially interesting to the engineer and mechanic, as well as the public at large.

Delegates with their families and friends, from all parts of the State, will be here, and every opportunity will be afforded the exhibitors to display their lines to the very best advantages.

The committee in charge of the convention and exhibition are: P. L. Ennor, president; A. C. Arbuckle, secretary; Chas. Dick, treasurer; W. M. Jenkins, H. W. Noethig, John Traynor, B. E. George, M. W. Herzog, J. L. Davies, John W. Carter, J. E. Green, D. E. Brewer, business manager, office No. 830, Monadnock Building. Telephone Kearny 5855.

NEWS OF THE STEAM ENGINEERS.

California No. 3, National Association of Stationary Engineers, held their regular meetting on the evening of March 17th and many matters of interest to the engineers were discussed, upon the conclusion of which, upon the invitation of Mr. H. D. Saville, chief engineer of the Merchants' Exchange Building, the members adjourned to the exchange room to witness the operation of an extremely ingenious mechanical contrivance—an orange-wrapping machine, which wraps oranges with labeled paper at the rate of a carload a day. The inventor, Mr. Ballard, went to great pains to explain the intricate workings of this more than human machine, and the engineers considered themselves well repaid for the time spent in viewing it.

The educational committee of the association desires to announce that on the evening of March 31st Mr. Baker, district engineer of the Westinghouse Machine Company, will give an illustrated lecture on the Parsons steam turbine at the association's rooms, which promises to be fully as interesting and instructive as those given by Mr. Davis recently on the Curtis turbine.

A cordial invitation to attend this lecture is extended by this association to anyone interested in this subject.

DAVID THOMAS, Secretary.

BOOKS RECEIVED.

"Heat Energy and Fuels," by Hanns Von Juptner, translated by Oscar Nagel, 306 pages, 6x9. McGraw Publishing Company, New York City, and Technical Book Shop, San Francisco. Price $3.00.

This is a translation of the first of four volumes by Professor Juptner dealing with chemical engineering After a general historical treatment of the origin and forms of energy, the author takes up the chemical technology of heat and fuels. The first three chapters are concerned with the measurement of high temperatures, and include a description of the various pyrometers by which this may be accomplished. The next section details the methods for determination of heat combustion both theoretically and practically, according as it is complete or incomplete. Types of both direct and indirect calorimeters are illustrated. The final chapters deal specifically with wood, peat, coal, charcoal, oils and gases, giving in each case the method of analysis and manufacture. Much of the matter has been condensed into tabular form for ready reference and comparison. While primarily of interest to the chemist and metallurgist, the book contains information of value to both steam and gas engineers, as it embodies recent experimental data. The chapters on the gasification of fuels are of especial value.

CURRENT COMMENT

The National Electric Light Association's twenty-second annual convention will be held at Atlantic City on June 1, 2, 3 and 4.

Blast furnace gas power lost amounts to nearly 2,000,000 h p., although this is being reduced by the installation of gas engines to consume the power.

The production of gas from peat is to be experimentally tried by the Canadian Government, which has appropriated $15,000 for a fuel-testing plant at Ottawa.

A self-igniting flame with high intrinsic illuminating power is produced when a mixture of calcium carbide and calcium sulphide is thrown into water.

Electric propulsion for Atlantic liners is under experiment by British engineers, who figure that electric drive will increase the speed of rotation of the screws.

Examination for tracer of mechanical drawings in the Panama Canal Service is announced by the United States Civil Service Commission on April 21, 22, 1909. The entrance salary is $100 per month.

A new aluminum alloy consisting of 87 per cent aluminum, 8 per cent copper and 5 per cent zinc has been patented by Fried. Krupp, of Germany. It casts easily, is homogeneous, easily worked and very brilliant.

Calcium carbide annual production is nearly 200,000 tons, of which the United States and Canada furnish 38,000, Italy 32,000, France 27,000, Norway 25,000, Switzerland 20,000, Austria-Hungary 20,000, Sweden 12,000 and Germany 9,000.

Electric fans for picking chickens has been devised for wholesale poultry dealers. It is stated that all the feathers and down are removed in a few seconds by placing the dead chickens into a receptacle equipped with a powerful electric blower.

Lusol is an impure benzine resulting from the distillation of coal tar, which furnishes a cheap light by means of a specially designed lamp and mantle. It is finding considerable application in France, as it costs one-fifth as much as kerosene.

Transmission of wireless messages over water is better than over land, possible because the radioactive emanations from the earth, which make the air conductive, interferes with the transmission of electric waves. No such radiations arise over water.

One charge ran an electric automobile 142 miles at an average speed of fourteen miles an hour in a test recently completed by a prominent manufacturer. The car ran eighty-five miles the first day and completed the trip next day after standing over night.

The most powerful wireless station in the world is to be erected by the Government at Washington, D. C. A 600-foot tower is to be put up and instruments provided that will be powerful enough to be beyond interference by commercial wireless stations. The total cost is estimated at $182,600.

Producer gas differs from water gas primarily in the source of the oxygen, the former getting it from the air, the latter from water. In each case carbon monoxide is produced by passing either air or water over glowing carbon. On account of the hydrogen present in water gas it has from two to three times the theoretical thermal value of producer gas, according as it is produced at low or high temperature.

The production of nitric acid in this country is 108,380,387 pounds annually, valued at $5,232,527. This is manufactured by 41 companies all using sulphuric acid and sodium nitrate. The production of nitric acid from the nitrogen of the atmosphere by an electric arc has been introduced only experimentally.

The reduction of metallic oxides by carborundum takes place at the comparatively low temperature of 1,300 degrees C. The reaction is much like that of powdered aluminum in the thermit process. Experiments by Baraduc Muller in France that various alloys such as ferro-silicon can thus be made without the use of an electric furnace.

Wireless telegraphy in Brazil is under the control of a commission composed of representatives of the national telegraph department, the army and the navy. It has charge of the establishment of a wireless telegraph system for all Brazil, not only with respect to a system for army and navy and other national purposes, but for a public service as well.

A wireless typewriter has been designed by H. Knudsen, the inventor of the system of photo-telegraphy bearing his name. By means of a transmitting typewriter various electrical impulses corresponding to the several letters of the alphabet are sent out and received on a similar typewriter or linotype through a detector and relay. It thus becomes possible for one operator to set type on any number of receiving machines on land or sea.

The largest testing machine yet constructed is being built for the Structural Material Testing Laboratories of the United States Geological Survey. It is essentially a large hydraulic press with a maximum clearance of 65 feet between heads. It is to have a capacity of 10,000,000 pounds pressure with an accuracy of at least one-third of one per cent for loads of 100,000 pounds or more. Its primary purpose is to determine the effect of flaws and other defects in large blocks of natural stone.

Hydro electric power for fertilizer manufacture is being sought by representatives of European interests utilizing atmospheric nitrogen. A report from the consular service states that an industry of this kind is needed, as the imports of Chilean nitrate of soda now amount to $14,000,000 a year. Difficulty is being experienced, however, in securing suitable water powers at reasonable cost. Governments of other countries are said to be offering inducements for the location of the extensive nitrate mills which the company proposes to erect.

The use of electricity on the farm was recently demonstrated at an electrical exposition at Marseilles, France, in which neighborhood agricultural labor is at a premium because of the migration to the cities. An exhibit of a modernized farm occupied 12,000 square feet. Water was raised from a well by a motor-driven centrifugal pump. Plows, threshing machines, huskers, winnowers, etc., were all motor-driven. The wine cellar was equipped with a wine pump, grape picker and press, all electrically operated. The poultry yard contained a bone crusher, herb cutter, electric brooder and breeder. In the barn was an electric carrot cutter, grain crusher, oil cake mill, root cutter and straw cutter. The cows were milked and the sheep sheared by electricity. The dairy had an ice-making machine and was furnished with electric-driven cream separators, heaters and churns. All shop tools were electric driven, including the forge blower. The home and laundry were also supplied with all the modern conveniences offered by electricity.

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POWER AND GAS

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CONTENTS

Business Training of the Engineer.

There are few better trained business men than engineers, graduation speeches notwithstanding. So often has the engineer's lack of business training been deplored that some people are beginning to believe that it is true. The cause of this misconception is two-fold, first, in regarding an inexperienced student as an engineer, and second, in a mistaken idea as to what constitutes business.

A recent graduate from an engineering college, as a rule, has not the same business experience as is possessed by a young man of the same age engaged in mercantile pursuits during the time of the student's technical training. This business handicap may be so great as to relegate the engineer to a subordinate position, just as some other deficiency fills the ranks of clerks and bookkeepers. But a successful engineer, after a few years' experience in handling men and affairs, is as good a business man as his commercial brother.

In America "the product of the industrial and commercial age, the age of prose," the meaning of business as given us, "a pursuit or occupation that employs or requires energy, time and thought," is usually misconstrued as applying only to commercial and financial pursuits. Energy, time and thought are as essential factors in an engineering project as are "attention, application, accuracy, method, punctuality and dispatch," which fifty years ago were defined by Samuel Smiles as "the principal qualities required for the successful conduct of business of any sort." It is only by the closest attention to detail and by the most unremitting application that an engineer is enabled to design and construct a system in accordance with commercial requirements of rapidity and accuracy. Where is there a business where a mistake carries with it such disastrous consequences? How much finer is this conception than is the modern tendency to approve cunning and sharp practice as the necessary attributes of a successful business man.

An engineer supervising a power installation should not be expected to show marked ability as a financier any more than a banker is expected to design bridges. Each is a specialized business requiring expert knowledge. The business of engineering is concerned with the "art of directing the great Sources of Power in Nature for the use and convenience of man." It is thus doing a greater work in advancing our material welfare than is accomplished by piling up dollars. The pyramids of Egypt are yet standing, although the wealth of Croesus is but legendary.

PERSONALS.

H. F. Froesch, Pacific Coast representative of the Federal Electric Company, is in Los Angeles.

W. S. Heger, assistant to the president of the Allis-Chalmers Company, Milwaukee, Wis., is now in San Francisco.

Mr. S. C. Dyke, of the Electric Porcelain Company, East Liverpool, O., spent the past week in San Francisco.

Dorsey Ash, Asso. M. Am. Soc. C. E., announces that he has removed his office to the Mills building, San Francisco.

R. B. Cressman, representing Pass & Seymour, Inc., of Solway, N. Y., is in Los Angeles, whence he will come north.

W. S. Berry, sales manager of the Western Electric Company, San Francisco, left for an extended trip through the East on March 24, 1909.

T. C. Turley, president of the Chicago Insulated Wire and Manufacturing Company, was in San Francisco last week with William Knight of Los Angeles.

M. E. Laumbranch, railway selector expert of the Chicago office of the Western Electric Company, and Mr. E. K. Dyer, traveling telephone expert for the same company, are in San Francisco in attendance on the conference of superintendents of railway telegraph, which has been in progress during the past week.

BOOKS RECEIVED.

"Theory and Calculation of Transient Electric Phenomena and Oscillations." By Charles Proteus Steinmetz. 556 pages, 6x9; 102 diagrams. McGraw Publishing Company, New York City, and Technical Book Shop, San Francisco. Price $5.00.

Transient electrical phenomena are those which accompany the readjustment of the energy stored in an electric circuit containing resistance, inductance and capacity. Although they exist for but a short time or space until permanent conditions are established, their instantaneous value may be great enough to destroy the circuit unless it has been designed to withstand these extraordinary conditions. Their nature, their occurrence and their magnitude are analytically discussed in this volume. Beginning with the simplest case, involving either resistance, inductance or capacity, the author successively takes up cases involving any and finally all of these factors, deducting mathematical expressions for their value. The treatment is broadly divided into four sections, treating respectively of transient phenomena in time, periodic transient phenomena, transient phenomena in space, and transient phenomena in time and space.

Under the first head is given a general explanation and definition of the constants of an electric circuit, and an investigation and discussion of the simpler forms of transient terms, such as the starting of a continuous current lighting circuit, the excitation of a motor or generator field for either direct or alternating current. It includes a complete treatment of oscillating currents and of low frequency surges in high potential systems. An analytical discussion is given of a divided circuit and of mutual inductance. Finally a formula is derived for the determination of a general system of circuits, with specific attention to magnetic saturation and hysteresis, the transient term of the rotating field and short circuit currents of alternators.

Periodic transient phenomena of engineering importance include those occurring in the control of an electric circuit, in the operation of high frequency currents and in the rectification of alternating currents. Each of these are discussed in detail, particular attention being given to rectification, both mechanical and arc. The chapter on the mercury arc rectifier is remarkably lucid in its explanation.

Under transient phenomena in space is discussed long-distance transmission lines and high potential transformers. A section is devoted to an analytical discussion of the distribution of magnetic flux and of alternating current, and one takes up the velocity of propagation of an electric field. The concluding chapters give calculations of conductors intended to convey current of very high frequency, such as lightning discharges, high frequency oscillations in transmission lines, and currents used in wireless telegraphy. In the last section the author first deduces a general expression for the current and voltage of an electric circuit. The section includes a discussion dealing with standing waves, traveling waves and free oscillation, in simple and complex circuits, concluding with illustrations of the effect of the discharge of an inductance into a transmission line.

All of these phenomena are graphically illustrated by curves and oscillograms which facilitate comprehension of the text. The treatment is essentially mathematical and can be comprehended only by one thoroughly versed in the calculus. The subjects discussed include some of the most important problems yet to be met in the field of electrical engineering, and while some of these are today of but scientific interest, it will be but a comparatively short time before their industrial application will demand attention. The man who has thoughtfully assimilated the contents of this volume will be in a position to solve practical problems. The book is above ordinary criticism and on the same high plane as the "Theory and Calculations of Alternating Current Phenomena," by the same author, which has ever been recognized as the standard.

"Practical Calculation of Transmission Lines," by L. W. Rosenthal, 93 pages, 6x9. McGraw Publishing Company, New York City, and Technical Book Shop, San Francisco. Price $2.00.

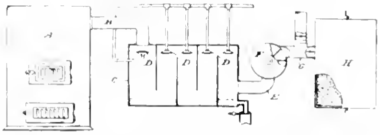
This book bridges a gap that has long existed in the line of electrical engineering, as it presents a direct method for the accurate and rapid calculation of conductors for direct and alternating current distribution. It consists essentially of formulas accompanied by tabulated data and constants for the solution of wiring problems, all illustrated by numerous practical examples. The text is divided into six chapters, treating successively of direct current distribution for light and power; distribution for direct current railways; alternating current transmission by overhead wires and by underground cables; interior wiring for alternating current distribution and distribution for single phase railways. A number of existing fallacies are pointed out and as many new and original methods offered. Among these is one for determining the size of wire directly from volt losses in the line. Much time can be saved by using the several short-cut methods detailed. It is necessary, however, in all of these to use the author's tables, as the formulas are largely empirical.

SAN FRANCISCO, CAL.—Articles of incorporation of the Equitable Light & Power Company, capitalized at $750,000, have been filed with the County Clerk of San Francisco. The purposes of the company are stated to be, to make, provide, and supply electric current, water, water power, steam and electricity, electric light, heat and power to the city and county of San Francisco and to other cities and towns in the State. There is no mention of gas in the articles. Of the capital, $700 has been subscribed, each of the seven directors having paid for ten shares. The directors are C. B. Beal, general manager of the Bay Cities Water Company; Frederick G. Cartwright, A. E. Long, Leo G. Meyberg, Mountford S. Wilson, M. D. Levenson and James Fisher.

"The Electrical Operation of Railroad Shops" is the subject of Bulletin No. 4649 from the General Electric Company. The illustrations show independent drive of several machine tools.

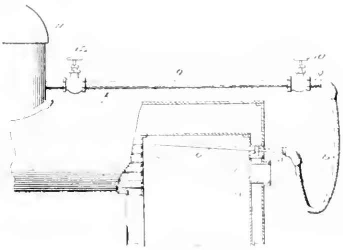
PATENTS

914,279. Process of Obtaining Nitrogen From Air. Oliver P. Hurford, Chicago, Ill. The process of obtaining free nitrogen from the air which consists in first burning a carbonaceous fuel in the presence of air of sufficient quantity for complete combustion to carbon dioxid and substantially free from



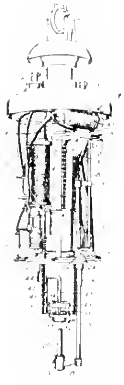
carbon monoxid, then subjecting the gaseous products to the condensing action of water to condense the steam and separate the carbon dioxid from the nitrogen and then leading off the nitrogen from the condensing chamber, substantially as described.

914,940. Boiler-Flue Cleaner. James J. Flynn, Atlanta, Ga. In a boiler-flue cleaner, the combination with a boiler having an opening formed in one end thereof, a tube adapted



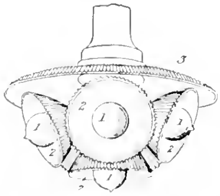
to be projected through the opening and to engage successively the flues in said boiler, a baffle plate formed with means for permitting a universal movement of said tube, and flexible means connected with a supply of gaseous pressure.

914,939. Electric-Arc Lamp. Richard Fleming and Cromwell A. B. Halvorson Jr., Lynn, Mass., assignors to General Electric Company. In an arc lamp, a frame work, an



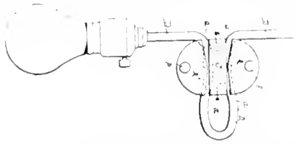
electrode comprising an annular member, means for securing said member as a whole in a position relative to the frame work which is independent of the duration of an arc therefrom, an axial member, and means for causing relative movement between said members whereby the arc is started from one of said members and transferred to the other of said members.

915,056. Illuminator. Van Rensselaer Lansingh, New York, N. Y., assignor to Holophane Glass Company, New York, N. Y. An illuminating device comprising a group of



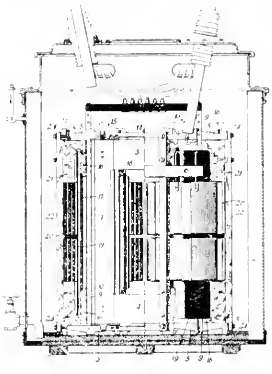
lights, an independent prismatic glass reflector for each light and a prismatic glass master reflector common to and inclosing all the lights and adapted to reflect the combined light in a downward direction.

914,768. Electric-Light Cord or Cable Adjuster. Frank E. Walker and Arthur C. Walker, River Point, R. I. An electric-light cord or cable adjuster consisting of a base, a block



removably mounted on said base and having a concave groove in each side clamping members, each provided with a convex groove in one side, said side having two cam-faces or straight edges converging mediately of said side, said clamping members pivotally mounted on said base at opposite sides of and adjacent to said block in such manner that the convex groove in said member and the concave groove in said block will conjointly constitute a curved passage-way for the cord or cable.

914,941. Transformer Structure. Charles Le G. Fortescue, Wilkinsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. In a transformer, the combina-



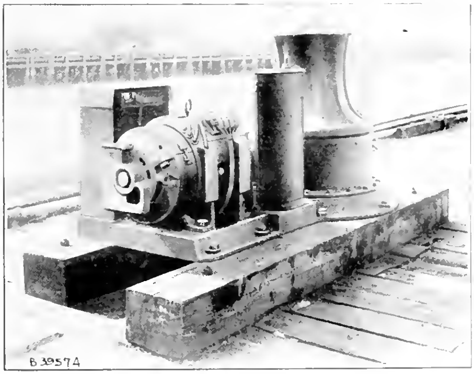
tion with a magnetizable core comprising a plurality of substantially parallel legs, and cross members joining the same, of brackets at the ends of the core legs, means for connecting the brackets at the respective ends of the core, means for clamping the core legs between and substantially concentric with the brackets at the ends thereof, coils surrounding the legs, and means for maintaining the coils in substantially invariable relations with respect to the said legs.

INDUSTRIAL

ELECTRIC MOTORS ON DOCKS.

The convenience of electric motive power is well illustrated in the applications shown in the accompanying views where electric motors are shown connected to a capstan and winch for use in hauling vessels up to the dock. In each case the outfit is entirely self-contained with the entire outfit on a single bedplate, which insures correct alignment of the gearing even after long service. This construction makes the installation of the outfit a simple matter, as it is only necessary to bolt the bedplate to a secure foundation and connect the motor to the power circuits. The location of the capstan may be chosen without reference to the power, for the wires may be run anywhere on the dock with much greater convenience at a substantial saving as compared to any other method of supplying power.

The illustration shows one of the two electric capstans supplied by the American Ship Windlass Company of Providence, R. I., to the Newport News Shipbuilding and Drydock



Electric Capstan.

Company, which they installed on piers in their shipyard at Newport News, Va.

With a capstan on each pier at the entrance of the drydock it is possible to haul the ships in very rapidly and accurately. The dock is one of the largest at any of the shipyards in the world and will take the largest American battleships afloat. It may readily be appreciated that powerful machines are required to do such work. Each winch is designed to pull 11,000 pounds at 30 feet per minute. The motors are standard Westinghouse, Type "K" series, wound motors running at a full load speed of 500 rpm. The speed is controlled by a standard Westinghouse R 27 controller.

The capstan is known as a 16" electric gypsy; that is, the barrel is 16" in diameter at the smallest part. The hauling rope is merely wound around the barrel four or five times and the loose end of the rope overhauled as the vessel is pulled into the dock by the winches. The winches were furnished by the American Ship Windlass Company of Providence, R. I.

The mining regions of Canada, Mexico and the Americas form a particularly fertile field for the application of gas power, owing to the high price of fuel. Plants similar to the above are in operation at Calgary, Canada; Wetaskiwin, Alberta, Canada; Cobalt, Ontario, Canada; Moncton, Canada; Bahia Blanca and Buenos Ayres, Argentine Republic; Iquique, Chile; Santos and Rio Janeiro, Brazil.

BENJAMIN TUNGSTEN FIXTURES.

The Benjamin Electric Manufacturing Company, with San Francisco headquarters at 161 New Montgomery street, have placed upon the market a number of tungsten devices supplementing their popular line of Tungsten Arcs and Adapters. Fig. 1 is their Two-Light Tungsten Adapter. It is furnished with rotating sleeve which makes it possible to attach

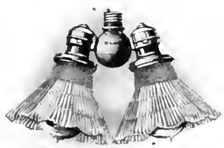


Fig. 1.

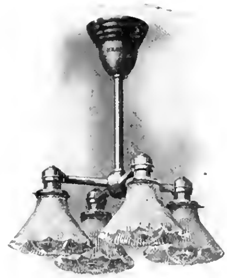


Fig. 2.

the device without turning. It is especially useful as a device for burning two lamps in series. Fig. 2 illustrates one of several new tungsten fixtures. The company has recently issued a new Bulletin No. 3, which is handsomely illustrated and contains valuable information on the use of tungsten lamps. It will be sent to any address upon request.

TRADE NOTES.

As a result of their steadily growing business and the resulting increase in stock, the Telephone-Electric Equipment Company have found it necessary to secure new quarters in San Francisco and are now located in the Merritt building, a modern fireproof structure at 612 Howard street.

Difficulties experienced in the past as a result of the separation of their general offices, sales rooms and warehouse have been overcome by bringing together in one building their entire organization, with ample floor space for a largely increased stock.

Among other lines they handle on the Pacific Coast are Simplex wires and cables, American copper and weatherproof wire, Stromberg-Carlson telephone apparatus, H. & H. switch goods and National Metal, Molding and Conduits.

Otis & Squires, manufacturers representatives, who have been located at 645 Howard street, San Francisco, for the past four months, will settle permanently on April 1, 1909, at 155 New Montgomery street.

TRADE CATALOGUES.

Bulletin No. 4646 from the General Electric Company is devoted to the G. E. tungsten incandescent lamp, for standard lighting service, 100 to 125 volts, 25, 40, 60, 100 and 250 watts. Bulletin No. 4647 shows the adaptability of G. E. tungsten lamps for series street lighting.

The Western Electric Company, New York and Chicago, has issued a unique booklet entitled "Satisfaction." This shows a number of photographs of President Taft using a Western Electric telephone. The facial expressions substantiate the title of the booklet. There are also a number of excerpts from the writings of Mr. Taft.

APPROVED ELECTRICAL DEVICES

CONDUIT OUTLET BUSHINGS.

½-inch aluminum coated single piece bushing. Approved Feb. 20, 1909 Manufactured by

P. R. Mfg. Co., 621 Bellevue Ave., Detroit, Mich.

CONDUIT OUTLET BUSHINGS AND COUPLINGS.

Enameled or tinned condui: outlet bushings for all sizes of rigid conduits. Approved Feb. 26, 1909. Manufactured by

Gradler Mfg. Co., Cleveland, Ohio.

FIXTURES.

"Benjamin" Tungsten Arcs, indoor and weatherproof forms, 4 to 6 and 2 to 4 light types. Nos. T-44, T-44-K, T-46-K, T-62, T-63, T-64, T-83, T-84 and T-85. Approved Feb. 23, 1909. Manufactured by

Benjamin Electric Mfg. Co., 42 W. Jackson Blvd., Chicago, Ill.

GROUND CLAMPS.

Adjustable ground clamps of copper, for use with ⅜ to 2-inch pipe. Approved Feb. 16, 1909. Manufactured by

American Metal Works, Germantown, Philadelphia, Pa.

INSULATING PAINT.

"Mogul" Electrical Compound. Approved March 3, 1909. Manufactured by

A. Grothwell, 352 West 25th St., New York, N. Y.

MISCELLANEOUS.

"O. K." Meter Connection Block. A porcelain cut-out block and metal cabinet designed for use in connecting wires to meters. Approved Feb. 26, 1909. Manufactured by

Pettingell-Andrews Co, 160-166 Pearl St., Boston, Mass.

RECEPTACLES—STANDARD.

"Bryant" 3 A. 250 V. Sign. Cat. Nos. 1700, 40188, 46749, 59108. Cleat, Cat. Nos. 9402, 9403, 921, 1011, 1123, 50715, 11221, 28795, 58949 (formerly 23209), 58300, 58301 (formerly 23210). Concealed, Cat. Nos. 50744, also 9447, fusible 2 A. 125 V. Moulding, Cat. Nos. 42543, 58302, 58950 (formerly 34152) Conduit Box Cat. Nos. 9514, 9397, 40507. Rosette Receptacles cleat and concealed types, fusible 2 A. 125 V. Cat. Nos. 9434, 9436, 9438, 9404, 9405, 9406 Approved Feb. 21, 1909. Manufactured by

The Bryant Electric Co., Bridgeport, Conn.

RECEPTACLES—STANDARD.

"P. & S." Receptacles. 3 A. 250 V. Cleat, Cat. Nos. 870, 871, 821. Moulding, Cat. Nos 670, 770. Removable Ring types, Cat. Nos. 577, 578, 877, 988. Sign, Cat. Nos. 973, 977, 975, 777, 1072, 821. Cat. Nos. 960 and 960 A. to F. incl. porcelain sign receptacles having lead wires soldered to terminals and sealed. Receptacles spaced on wires from 3 to 10 inches. Cat. No. 900. A double porcelain receptacle for use only in borders of double faced metal panel signs. Approved Feb. 19, 1909 Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

RECEPTACLES—STANDARD

"P. & S." wall sockets 3 A. 250 V. (keyless) brass shell, Cat. Nos. 387, 0387, 455, 456, 367, 480, 481; Cat. Nos. 468 and 469, with metal keys Porcelain shell, Cat. Nos. 2371, 02371, 237, 0237, 247, 0247, 1087, 107 Approved Feb 26, 1909. Manufactured by

Pass & Seymour, Inc., Solvay, N. Y.

RECEPTACLES—STANDARD.

"Tregoning" Receptacles. 3 A. 250 V. Cleat type, Cat. No 303. Sign, Cat. Nos. 300, 301, 302. Approved Feb. 23, 1909 Manufactured by

Tregoning Elec. Mfg. Co., 224 High St., Cleveland, Ohio.

RHEOSTATS.

"G. E." all capacities, 125-500 V. S. A. and S. B. Motor starting. SFA motor starting with field control. RA speed regulating, for continuous duty. Also, SO, RO and SFO with overload release devices which are inoperative during process of starting motor. Approved Feb. 22, 1909. Manufactured by

General Electric Co., Schenectady, N. Y.

ROSETTES, FUSELESS.

3 A 250 V. "Fielding" Rosettes, cleat, concealed and moulding types. Cat. Nos. 433-438, incl., 441, 480. K. W. Rosettes. Cat. Nos. 481, 482. Approved Feb. 20, 1909. Manufactured by

H. T. Paiste Co., 32d and Arch Sts., Philadelphia, Pa.

SOCKETS, MINIATURE.

Miniature and Candelabra Sockets, ½ A. 125 V. Pendant Cat. No. 323. Candelabra Candle Socket, Cat. Nos. 327, 328 and 347. Approved Feb 26, 1909. Manufactured by

Bryant Electric Co., Bridgeport, Conn.

SWITCHES, PENDANT SNAP.

"C. H." all porcelain. 6 A. 125 V.; 3 A. 250 V. for pendant use. Cat. No. 7000, with brass cap for fixtures or pendants. Cat. Nos. 7001 and 7002. 10 A. 125 V.; 250 V. pendant style. Cat. No. 7010. Approved Feb. 20, 1909. Manufactured by

Cutler-Hammer Mfg. Co., 12th St. and St. Paul Ave., Milwaukee, Wis.

SWITCHES—PENDANT SNAP.

"Perkins" 2 button type, single pole, 10 A. 125 V. 5 A. 250 V. Cat. Nos. 2353 and 2354 for either pendants or fixtures and 2359 for pendants only. Approved Feb. 19, 1909. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

SWITCHES—ROTARY FLUSH.

"Perkins" 3 pole snap switches with vulcabeston commutator, 15 amperes, 250 volts, Cat. No. 2185, lock type No. 2050. Switch is provided with a special fibre lined brass collar and a cast brass mounting frame which are screwed to the porcelain base of the switch by means of screws and mounting posts. Approved Feb. 15, 1909. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

SWITCHES, SURFACE SNAP.

"Perkins" three-pole snap switches with Vulcabeston Commutators, 15 A. 250 V. Cat. Nos. 2025, 2026, 2045, 2046. Approved Feb. 13, 1909. Manufactured by

Perkins Electric Switch Mfg. Co., Bridgeport, Conn.

TRANSFORMERS.

Electrolytic rectifier. A device consisting of a small transformer, a pair of aluminum cells and two storage cells with necessary connections and terminals, all enclosed in a substantial iron cylinder with grated cover. Primary of transformer to be connected by means of approved reinforced flexible cord and attachment plug to 125 volt A. C. circuit. Through the action of transformer and aluminum cells the storage cells are charged and from them a four volt D. C. current may be taken for operating an electrically driven piano-player or other suitable device. Approved Feb. 20, 1909. Manufactured by

Electrelle Company, 1011 Diamond St., Philadelphia, Pa.

WIRES, RUBBER-COVERED.

Marking: Red and black threads parallel with wire between rubber insulation and braid. Approved Feb. 17, 1909. Manufactured by

Electric Cable Co., Bridgeport, Conn.

NEWS NOTES

FINANCIAL.

PASADENA, CAL.—Bonds have been issued here to the amount of $150,000 for extending the lighting facilities.

EL CENTRO, CAL.—The city Trustees propose issuing bonds to the amount of $50,000 for installing a domestic water system here.

SIERRA MADRE, CAL.—An ordinance has been introduced by the Trustees of this city calling for the sale of $30,000 in bonds for a municipal gas plant.

GLOBE, ARIZ.—The City Council proposes issuing bonds, which are to be sold to Ulen & Sutherlin, of Kansas City, to the amount of $275,000, for building a municipal water plant here.

SAN FRANCISCO, CAL.—The Pacific Telephone & Telegraph Company's bonds to the amount of $15,000,000, being part of the $35,000,000 issue authorized in 1907, have been bought by J. P. Morgan & Co., of New York. Henry T. Scott, of the Pacific Telephone & Telegraph Company, says: "The money will be used to improve the service on the Pacific Coast. It is the intention of the company to extend its lines and to install at least 50,000 new telephones this year."

SAN FRANCISCO, CAL.—The earnings of the United Railroads for the year 1908 show a substantial increase over those of 1907. The gross earnings for the year 1908 are given as $6,866,303, and for 1907 as $4,745,116, showing an increase of nearly 50 per cent. The net earnings for 1908 are given as $2,623,553, and for 1907 as $1,305,517, showing an increase of more than 100 per cent. The monthly earnings show a continual increase. In November, 1908, the gross earnings were $574,422, against $449,732 for the same month in 1907; December, 1908, the net earnings were $260,332, against $134,522 for the same month in 1907.

SAN FRANCISCO, CAL.—The annual report of the Associated Oil Company shows the company's earnings for 1908 to be $2,237,236.91 and the net gain $1,521,520.74. The total sales of oil in 1908 exceeded those of 1907 by only 6 per cent, but the net realization per barrel was 30 per cent higher. During the past year there has been a marked increase in the selling price of oil, which was due largely to decrease in development work of all the producing companies throughout the State. The production at present is slightly greater than the consumption. During 1908 sixty-five new wells were completed and five old abandoned wells were put in action, making the production total 310, as against 240 at the close of 1907. The new wells opened were as follows: Kern River, 41; McKittrick, 15, and Coalinga 9. The total production increased about 52 per cent, while the cost of production was about 10 per cent less. The Associated Pipe Line Company, a sub-company of the Associated Oil, completed, during the year, 282.7 miles of eight-inch riffed pipe line from Bakersfield to Port Costa. The Associated Transportation Company, of which the Associated is the largest stockholder, finished during the year the Santa Maria-Gaviota line of 30.53 miles. Two storage stations have been completed, one at San Francisco, capable of holding 85,000 barrels, and the other at Redondo, capable of holding 66,000 barrels. Also tonnage for 241,700 barrels at Port Costa, the terminus of the riffed pipe line, has been established.

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Red Wing Oil Company has been incorporated here with a capital stock of $500,000 by J. S. Corrigan, H. F. Clarrage, M. J. Jordan, J. J. McKinzey and J. D. Bell.

PHOENIX, ARIZ.—The Coalinga-Alladin Oil Company has been incorporated here.

SAN BERNARDINO, CAL.—The Needles Light & Power Company has been incorporated here with a capital stock of $50,000 by W. B. Palmer, W. W. Perry and M. P. Thye.

SAN LUIS OBISPO, CAL.—The Crown Oil Company has been incorporated here with a capital stock of $500,000 by R. A. Wickenden, F. J. McHenry, A. C. Shuster, J. F. Godwin and G. P. Merritt.

LOS ANGELES, CAL.—The Arizona Petroleum Company has been incorporated here with a capital stock of $250,000 by W. T. Brown, J. A. Brown, A. Adams, W. M. Cloypool and A. J. Pickrel.

RHYOLITE, NEV.—A company known as the Pioneer Water Company is to be formed here with a capital stock of $300,000. The incorporators are B. L. Smith, J. J. Owens and Len P. McGarry. The company proposes to build a pumping station and reservoir at Crystal Springs and install a pipe line to this city.

SAN FRANCISCO, CAL.—The California Electric Generating Company, recently organized for the purpose of erecting an electric steam generating plant in Oakland, has issued a statement showing its working plans. The company's plant will be leased to the Great Western Power Company, and will be operated in connection with the Great Western power plant on the Feather river, in Butte county. The capitalization of the company is:

Stock.	Authorized.	Issued.
Six per cent authorized	$2,500,000	$600,000
Common	5,000,000	5,000,000

The power house is to be built of steel and masonry and will have a capacity of about 13,500 horsepower. The building is to be so constructed that at any time additions can be made with but little expense.

ILLUMINATION.

ONTARIO, CAL.—The Ontario Upland Gas Company has procured a franchise to lay thirty miles of pipe line from this city.

SAN DIEGO, CAL.—The City Council is now considering plans and specifications for the proposed ornamental lighting of Fifth street.

LOS ANGELES, CAL.—The City Council proposes installing ornamental lights on Main street, between Marchessault and Pico streets.

UPLAND, CAL.—Work has commenced on the installing of a modern gas plant at Ontario and service will be soon extended to this city.

EUGENE, ORE.—The Eugene Light & Power Company has been organized to develop 2,000 horse power on the McKenzie river. F. L. Chambers, of Eugene, is interested.

VALLEJO, CAL.—The Pacific Gas & Electric Company plans to spend a large sum purchasing new machinery and making extensive improvements at the local water works.

COALINGA, CAL.—Following the application of A. W. Smith and S. H. Hain for a gas franchise, the Trustees have advertised for and will receive bids up till April 1st for such a franchise.

REDLANDS, CAL.—The Edison Electric Company and the Home Gas & Electric Company have combined their interests here and have arranged that the gas and electric lines

will be handled by each company separately. The Edison Electric Company is to handle the electric business and the Home Company will ake over the gas management.

TRANSMISSION.

OROVILLE, CAL.—S. B. Crane and Earl Talbot propose to build an electric power plant in Butte county.

AGNEWS, CAL.—Bids for furnishing and installing conduit and electric wiring for the State Hospital will be received by the board of managers un'il 7 p. m., April 7th.

CHICO, CAL.—The Board of City Trustees will receive bids for the sale of franchise right to erect poles and wires for the transmission and sale of elec'ric power in this city on April 2d. Frank C. Wilson, of the Sierra Power Company, is the petitioner.

OROVILLE, CAL.—H. O. Lague has appropriated 25,000 inches of water from the Middle and Nor'h Forks on Nelson creek, in Plumas county. Mr. Lague has agreed with two Reno men, S. B. Crane and E. Talbot, to sell water for generating electricity at $2.50 for every horsepower generated.

CHICO, CAL.—The Oro Light & Water Company is now engaged in repairing the temporary barrier which was constructed to fill the break in the Miocene ditch dam on the west branch of the Feather river The company plans this summer to install a concrete dam.

RED BLUFF, CAL.—Application for two water rights, both for 10,000 inches of water from Mill creek, have been received here C. E. Burris proposes to divert the water into a flume seven feet wide and four feet deep, and carry the water along the right bank of the creek to a point where he is to erect an electric power plant. A. T. Forward proposes to use the water for power purposes also.

OIL.

MENDOTA, CAL.—The corps of United States Geological surveyors has traced the oil formation as far as Little Pinoche and have returned to Sacramen'o until a further appropriation is allowed for their work.

LOS ANGELES, CAL.—The oil producers of Southern California have sent a message to Senators Flint and Perkins and Representa ives McLachlan and Smith, urging them to oppose any revision which might be made in the oil tariff.

FRESNO, CAL.—The Sou'hern Pacific Railroad Company and its subsidiary organization known as the Kern Trading & Oil Company, have been sued by Edmund Burke to quiet title to certain sections which he claims as a placer mining claim.

BAKERSFIELD, CAL.—At a meeting of the stockholders of the Eldorado Oil Company directors were elected as follows: President, W. J Berry; secretary-treasurer and general manager, W. I. Roberts; T. M. Young, Charles Beckerdike, C. E. Baer, E. L. Keller and F. C. Berrg. Work will begin about April 1st on the new 10-acre lease which has been secured on the West Side, in the Kern River field.

MIDWAY, CAL.—The water question, which was the main topic in this vicinity a few months ago, has about been solved. The Santa Fe has completed its six-inch line from the Little Santa Maria Valley, above McKittrick, down through the Midway field This line was installed at a cost of approximately $100,000. The present three inch line is to remain for use in emergencies. By the Southern Pacific Company sending out water from Kern City, some 14 or 15 companies have availed themselves of this opportunity, and the Stratton water system is able to give better service to its customers. This company is now engaged in drilling another well, and contemplated laying an auxiliary line throughout the territory its pipes now cover.

TRANSPORTATION.

WALLA WALLA, Wash.—The Columbia & Walla Walla Valley Traction Company has started construction here.

SAN MATEO, CAL.—Frank H. Ames and W. H. Obear, of Los Angeles, have applied for an electric street car franchise here.

SAN JOSE, CAL.—The San Jose Traction Company has petitioned for a franchise to standardize the lines now owned by the San Jose Railroad Company.

HOOD RIVER, ORE.—The Valley Electric Railway Company has been organized, with E. T. Folts as president, to build a road into the Hood River country.

PHOENIX, ARIZ.—G. M. Halm, F. J. Bennett, B. A. Fowler, J. W. Dorris and C. A. King are interested in the Suburban Railroad Company, which plans an electric railway within the city limits.

SAN FRANCISCO, CAL.—At a mass meeting of the citizens of Bernal Heights district it was agreed to accept the offer of the United Railroad Company to furnish $15,000 of the $28,000 which is required to build a car line from Mission to Folsom streets.

LOS ANGELES, CAL.—A right of way through the Pasadena Cemetery, claimed by the Los Angeles & Pasadena Electric Railway Company, the Pacific Electric Railway Company, and others, is sought to be condemned by the Pasadena Cemetery Association in a suit filed in the Superior Court this week.

WATER.

CORNING, CAL.—John Simpson contemplates an early rehabilitation of his water works.

OCEANSIDE, CAL.—The Pacific Light & Power Company has plans for a reservoir at Warner ranch to cost $551,000.

WATSONVILLE, CAL.—Bids will be received up till April 9th for the construction of a complete water system in this city.

VALLEJO, CAL. — Cap'ain J. Gorham Nevins and B. Wiseman are planning to erect a salt water pumping plant to supply water for a bath house.

YUBA CITY, CAL.—Bids have been received by the City Clerk for the necessary equipment in the construction of a municipal water works for this city.

PETALUMA, CAL—Bids for furnishing and installing pumping machinery for a salt water high pressure system will be received by the City Clerk until May 5th.

BLACK DIAMOND, CAL.—The Black Diamond Water Company is making some extensive improvements to its plant. A large gasoline engine is to be installed shortly.

SACRAMENTO, CAL.—Plans are now being made with Professor Charles Gilbert Hyde, of the University of California, for the preparation of a municipal filtration plant.

TELEPHONE AND TELEGRAPH.

BERKELEY, CAL.—The Pacific States Telephone & Telegraph Company has about completed a number of improvements in this city which will cost upwards of $75,000.

SAN FRANCISCO, CAL.—The Postal Telephone & Telegraph Company, which recently took over the Nevada Telephone & Telegraph Company, has asked for a franchise to construct a telephone and telegraph line from Reno to Ely, via Carson City, Dayton, North Churchill, Goldfield and Tonopah. This company already has offices in Goldfield, Ely, Tonopah and Carson City, and as soon as the franchise is secured will begin building its line into Reno, where an office will be established.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer—who will listen with a willing and eager ear to the story of quality.
Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

ADAPTERS

LAMP ADAPTERS
Benjamin Electric Mfg. Co.
Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Perkins Elec. Switch Mfg. Co.

ALARMS

BURGLAR ALARMS
Edwards & Co.
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co
Stanley & Patterson, Inc.
Western Electric Co.

FIRE ALARMS
Edwards & Co.
Partrick, Carter & Wilkins Co.
Western Electric Co.

WATER ALARMS
Partrick, Carter & Wilkins Co.

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Johns-Manville Co., H. W., "J. W."
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Sterling Elec. Co.
Western Elec. Co

ASBESTOS

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INDEX TO ADVERTISEMENTS

BATTERIES

DRY BATTERIES

Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia." "King."
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Western Electric Co., "Blue Bell," "Liberty."

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Stanley & Patterson, Inc., "Patterson."

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Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY

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Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
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BELLS

ELECTRIC BELLS

Edwards & Co., "Rex," "Lungen."
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Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

ELECTRO-MECHANICAL GONGS

Edwards & Co.
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co.

MAGNETO BELLS

Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

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Henshaw-Bulkley & Co.
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Moore & Co., Chas. C., "B. & W."
Standard Engineering Co. "Robb-Mumford."
Tracy Engineering Company, Edge Moor."

BOOKS

Technical Book Shop.

BOXES

WALL BOXES

Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knockout."
Chicago Fuse Wire & Mfg. Co., "Union."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
General Electric Co.
Paiste, H. T. Co.
Pass & Seymour.
Sprague Electric Co., "Universal."
Standard Elect'l Wks., "M & M."
Stanley & Patterson, Inc., "Simplex"

BRACKETS

CEILING BRACKET AND DESK FIXTURES

Stanley & Patterson, Inc., "Sunlight."

DESK TELEPHONE BRACKETS

Stanley & Patterson, Inc., "Imperial."
Sterling Elec. Co. "Equipoise"
Western Electric Co.

IRON POLE BRACKETS

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Cutter."
Pierson, Roeding & Co.
Western Elec. Co, "Fletcher"

BUILDING CONTRACTORS

Watson, Sidney
Thorpe & Sons, J. T.

BURNERS

ELECTRIC GAS LIGHTING BURNERS

Edwards & Co.
Electric Goods Mfg. Co., "Advance."
Welsbach Company.
Western Electric Co., "Edwards."

CABLES

SUBMARINE AND LEAD-COVERED

American Electrical Works
Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
National Conduit & Cable Co., "National."
Okonite Co., "Okonite"
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
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Western Electric Co., "Hawthorne."

PAPER INSULATION

Belden Manufacturing Co.
Nat'l. Conduit & Cable Co.
Western Electric Co.

TELEPHONE CABLE

Dean Electric Co.
Kellogg. W. E. Co.

CARBONS

ARC LIGHT CARBONS

Brooks-Follis. Elec. Corp'n, The, "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg"

CIRCUIT BREAKERS

Cutter Co., The, "I-T-E." "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
Kierulff, Jr., & Co., B. F "Hartman."
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLAMPS

GROUND CLAMPS

Belden Manufacturing Co.
Bossert Electric Const. Co.
Chase-Shawmut Co., "Shawmut."
General Electric Co.
Paiste Co., H. T., "Perma-Effect."

CLEATS

FIBRE CLEATS

Blake Signal & Mfg. Co.

PORCELAIN CLEATS

General Electric Co.
Pass & Seymour
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Elec. Co., H. D. Sears, general sales agent.
Western Elec. Co., "Thomas"

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ARMATURE AND FIELD COILS

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FLEXIBLE CONDUIT

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Sprague Electric Co., "Greenfield."

RIGID CONDUIT

American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct." "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roeblings Sons Co., J. A. "Navalite."
Sprague Electric Co., "Iron Armored."

UNDERGROUND CONDUIT

Johns-Manville Co., H. W., "J.-M."
Pierson, Roeding & Co., "Fibre."
Roeblings Sons Co., J. A., "Bituminized Fiber"
Walworth & Neville Mfg. Co.
Western Electric Co., Agents Walworth & Neville Mfg. Co.

CONNECTORS

CABLE CONNECTORS

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Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F., Jr. & Co.

CORD

FLEXIBLE BELL CORD

American Electrical Works.
Belden Manufacturing Co.
General Electric Co.
Kierulff, B. F. Jr. & Co., "National."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roebling Sons Co., John A.
Simplex Elec. Co.
Western Electric Co.

LAMP CORD

American Electrical Works.
Belden Mfg. Co.
Elec. Appliance Co., "Paranite."
General Electric Co.
Okonite Co., The, "Okonite."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roeblings Sons Co., John A.
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Standard Und. Cable Co.
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TELEPHONE CORD

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FIXTURE CLUSTERS

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Perkins Elec. Switch Mfg. Co.
Weber Elec. Co., H. D. Sears, general sales agent.
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D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
Westghse Elec. & Mfg. Co.

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Westghse Elec. & Mfg. Co.

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General Electric Co.
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Western Electric Co.
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Moore & Co., Chas. C.
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Kieruiff, B. F., Jr. & Co., "American Diesel Engine."
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Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Standard Engineering Co.
Tracy Engineering Co., The
Westghse Machine Co.

FANS

DESK AND BRACKET ALTERNATING CURRENT FANS

Ft. Wayne Electrical Works.
General Electric Co., "G. E."
Standard Electrical Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

DESK AND BRACKET DIRECT CURRENT FANS

Electric Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co., "G. E."
Sprague Electric Co., "Lundell."
Standard Electrical Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

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Standard Elec. Wks., "Jandus." "Century."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

CEILING, DIRECT CURRENT FANS

Electric Appliance Co., "Colonial."
General Electric Company
Sprague Electric Co., "Lundell."
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Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

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Chicago Fuse Wire & Mf[g.] Co.
General Electric Co.
Pierson, Roeding & Co., "Aluminum."

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Elec. Appliance Co., "Cutter."
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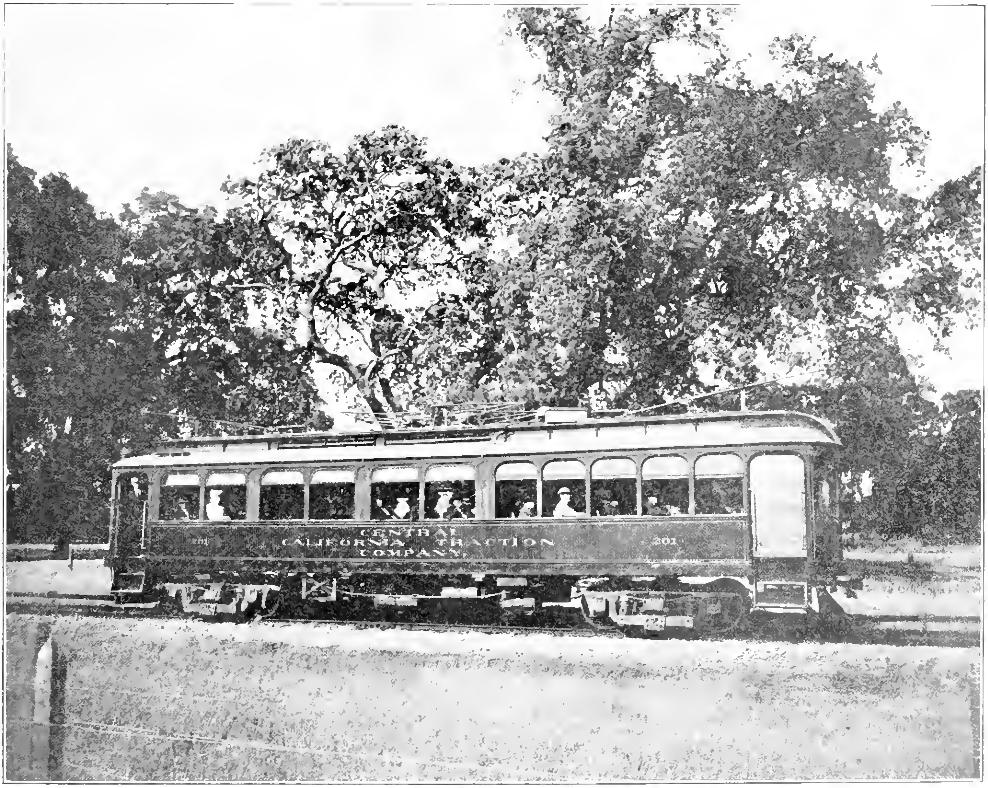
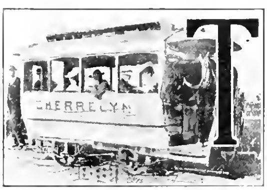
DIRECT CURRENT 1200 VOLT RAILWAY EQUIPMENT.[1]

BY S. B. McLENEGAN



1200-Volt Car of Central California Traction Company Equipped With 300 h. p.



THE past twenty years of electric railway development are amazing. As an illustration of this, a photograph from Denver, Colorado, shows the last of the old horse car lines now in operation, and in connection with which are some features which deserve special mention. At one portion of the line there is sufficient grade to enable the horse himself to ride in one direction, a platform being given up to him for that purpose. Here is a place where motor efficiency does not concern the company. So long as the horse retains his digestive ability the motive power may be regarded as reasonably efficient, but the price of hay and oats are matters of vital concern. As the opposite extreme of the picture you will note one of the 1200-volt cars of the Central California Traction Company at Stockton equipped with 300 horsepower. These two views are the extremes which

[1] Paper read before San Francisco Section, American Institute of Electrical Engineers, February 26, 1909.

illustrate better than words the progress achieved during the past twenty years.

We are, however, very far from perfection at this time. The slow and tedious process of evolution is still going on and we cannot tell what the coming twenty years will bring forth. Electricians have yet to devise a standard equipment upon which we may concentrate, but I believe that with the adoption of higher direct current voltages a very decided step has been taken toward this end. I sometimes look with envy upon our brethren of the steam roads. Every portion of their equipment is designed and constructed in accordance with accepted standards.

But it is a far cry back to the days of Stephenson, the father of the modern steam locomotive. Some of his experiments date back nearly a century, whereas many of us recall very distinctly the primitive types of Frank J. Sprague and others who occupy the same position in the development of electric railway motors. So far as the mechanical end is concerned we have already adopted many of the steam railway standards; the car body, truck, braking appliances and couplers having already been appropriated. The question of motive power is still complex and one which electricians have yet to satisfactorily solve. The requirements are not many. We need a motor which shall be efficient, economical and reliable in operation. In the railroad business there are troubles enough from without and we must avoid those from within.

The first cost of an equipment is not a primary consideration. Railroad companies can afford to pay a good price if the results are commensurate. By this I mean an equipment which shall stand up under the strain of everyday work with a minimum amount of failure and give results alike satisfactory in point of efficiency and maintenance.

With all the improvement made in direct current railway motors, the manufacturing companies until very recently have done nothing to improve the voltages hitherto employed. Practically every railway company using direct today is limited to 550 or 600 volts. Some of the longer lines have been forced to adopt alternating current, but with varying degrees of success. The General Electric Company has been the first to break away from the lower voltages by developing and placing on the market a motor not only capable of operating on 550 or 600 volts, but twice that amount of direct current. The guaranty of successful operation which went out with the equipment certainly indicated clearly that this company had faith in it and I take pleasure in saying that so far as my experience goes in the daily use of this system during the past year, it has fulfilled every reasonable requirement and justified everything said in its favor. The type used by the Central California Traction Company is known as the G. E. 205 and has a rated capacity of 75 horsepower at the voltage for which it was designed. This equipment should not be confused with the one employed on one or two Eastern roads which maintain 1200 volts on the trolley and have two 600-volt motors in series. This type employs 1200 volts straight on the motors.

The chief feature of this motor is the commutating pole which occupies the space between each of the four poles of ordinary railway motors. There are also some features of brush holder insulation which further distinguish it, but otherwise it bears all the outward earmarks of the best prevailing types of railway motors.

There is no indication of sparking at the commutator, either in starting, during acceleration or at full speed, and the commutator should give many years of service before requiring renewal. Many of the original carbon brushes received with the equipment, and which have been in service since June last, are still in daily use, and in these two matters at least the maintenance charges will be very low. All journals in the equipment from the axles upward, with the exception of the dynamotor, are lubricated by a grade of oil costing 20 cents per gallon in barrel lots and will operate upward of one thousand miles without re-oiling.

The standard equipment consists of four motors geared at a ratio of 23 to 51 for passenger service and 16 to 58 for freight service, and the former is designed to operate at a maximum speed of 50 miles per hour. Without load the complete car and equipment weighs about 70,000 pounds. At present the road is in operation between Stockton and Lodi, a distance of 15.5 miles, but there are extensions planned which will aggregate several times that length.

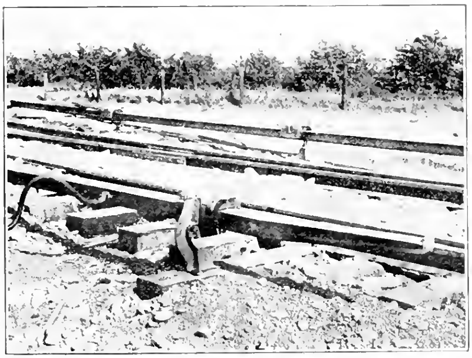
For a distance of two miles from the center of Stockton cars operate over an ordinary 550-volt line to a point where the private right of way commences. Over this section the maximum speed will not exceed 22 miles per hour. This feature is not objectionable, as it is very difficult to hold motormen operating high speed cars to the speed permitted by municipal requirements. So long as accidents are avoided, but little is said by authorities on this subject, but, when the fatal day arrives, the railway company permitting its cars to greatly exceed franchise stipulations, will find itself in an exceedingly difficult situation when brought into court. When the maximum speed is limited, as in this instance, to a moderate rate, it is not a difficult matter to show that cars were not operated at a dangerous speed, and, unless gross carelessness is shown elsewhere, a reasonable defense is always possible when accidents occur.

After reaching the private right of way outside of terminal points cars leave the trolley section and take power from the third or electric rail. Unlike others in use in California, this is known as the New York Central type, although instead of the bullhead rail conductor an ordinary 40-pound section is used, having about the capacity of a 400,000 c. m. feeder. An excellent view of this construction is shown in the illustration. In this you will note the rail is suspended from a malleable iron bracket which is spiked to a ten-foot tie. These are spaced twelve feet apart, or every sixth tie in the track. It is entirely practicable with this weight of conductor rail to spread the brackets and insulators fourteen feet apart, or, roundly speaking, every seventh tie in the track.

This will lessen the cost of construction materially without loss in stability. You will note the construction at crossings and switches. A section of the web about an inch in width and four feet in length is cut out and the rail end bent under heat in the shape of a sleigh runner. In order to prevent accidental contact with the live rail it is protected by a wooden covering between insulators. While no special trouble has

developed in the use of this, I do not consider it adapted in point of durability to the wet and dry seasons of California. It was predicted in some quarters that electrical trouble would result with a covering of this kind on a 1200-volt rail, particularly during the rainy season, but such has not been the case.

A much cheaper and more substantial covering can be made for this rail from ordinary rough lumber, cut in 3" and 6" widths and in lengths to suit the distance between insulators. This can be made up in the shops in the shape of a rectangular trough but without ends, and secured by either nails or screws through the side into a wooden filler fitted into the web of the rail, which prevents its removal. This may be further reinforced by a band of half oval iron around each end near the insulator. Any wooden covering should be dipped into a bath of hot asphaltum or other preservative which shall thoroughly impregnate the wood. This sort of covering is simple, inexpensive, and can readily be made up in the shop in large quantities and dropped into place from a work car as it passes.



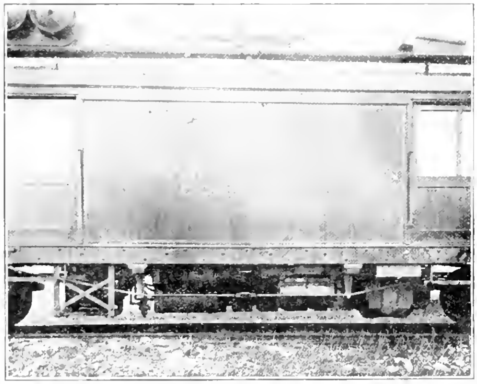
View Showing Construction of Third-Rail Shoe.

This type of third rail is very much superior to the ordinary exposed section. Repairs if any can be made by section men. There is no difficulty in replacing a broken insulator with current in the rail. One or two intelligent laborers are usually instructed for this purpose and become entirely satisfactory for all repair work. This consideration alone is of great importance in the use of the third rail wherever it is possible to adopt it, as maintenance charges are very low.

With overhead wiring it is necessary to employ a large force of linemen, and on the larger roads it is a heavy item of expense, all of which is done away with in the use of the third rail. This construction should not exceed $3100 per mile of track complete, which does not exceed the cost of good trolley construction. At best the trolley is one of the weakest features of electric railways, and, as a rule, delays to traffic are two to one arising from that source as compared with other causes.

As shown in the view of one side of an express car, all apparatus is suspended from two sub-frames of angle iron. These are rectangular in form and bolted from each of the four corners to the sills of the car. This has two advantages—first, it does away with cutting and weakening the frame of the car and, second, it makes it possible to insulate every portion of the apparatus from the floor of the car. With ordinary construction it is not unusual to find a "live" car during the rainy season, a feature which must be avoided in the use of the higher voltages. Suspended from the sub-frame on one side is the dynamotor and dynamotor contactor box.

Probably the most distinctive feature of the 1200-volt equipment is the dynamotor. The armature carries a commutator on each end of the shaft. The motor or 1200-volt end takes current direct from the third rail and the other generates and delivers 600 volts for the operation of the auxiliary equipment. The armature coils for the 1200-volt end are on top while those connected with the 600-volt end are on the bottom of the same slot. The dynamotor has a rated capacity of 10 kilowatts and the current generated operates the motor control circuit, lights, air compressor and heaters. This last apparently was not contemplated by



Side View of Express Car Showing Method of Suspending Apparatus.

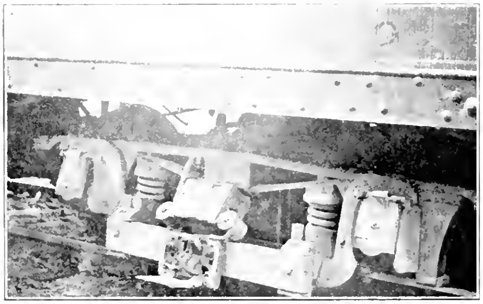
the manufacturing company, but when the subject of heaters arose it was not deemed advisable to permit the use of 1200 volts above the floor where heaters are necessarily located. The dynamotor armature is lubricated by a special grade of oil on account of the high speed at which it revolves. The dynamotor contactor box next adjoining contains two contactors, one 600 and one 1200 volt, which control admission of current to the dynamotor, or the reverse, according to the section of the line in which the car is operating and the voltage employed.

When the car passes from the 550 to 1200-volt section, there is a short stretch of "dead" trolley, in passing under which the 550-volt contactor drops out automatically. At the instant the third rail shoe makes a contact with the electric rail the 1200-volt contactor closes, causing the dyanmotor to start furnishing, as already stated, current for the auxiliary circuits. When the conditions are reversed and the car passes from 1200 to 550-volt circuits, the 1200-volt contactor opens automatically and the dynamotor ceases to operate as the auxiliaries then take current direct from the trolley. In this case, however, the motorman closes the 550-volt contactor by means of an electrically operated

switch in the cab before the trolley current is available. Both contactors cannot be closed at the same time so long as they are in operating condition. In passing from either trolley to third rail, or vice versa, the motorman also throws what is known as the transfer switch, which is also electrically operated. This device admits current from either the trolley or third rail and cuts off the one not in use. Both of these movements are made while the car is under full speed.

The master control consists of the ordinary Sprague-General Electric type M controller located in the cab at either end of the car and both connected by a ten-wire cable carried in loricated conduit. By means of current through the master controller and cable, the contactors, fourteen in number, are electrically operated. These establish motor control in individual cars whether operated singly or in multiple.

The location and construction of the third rail shoe, wooden shoe beam for insulating purposes and fuse box are shown in the accompanying view. The fuse box is built up of horn fibre and is supplied with a ribbon fuse. Blowout coils are provided where shown to take care of arc when from any cause the fuse burns out.



Wood Insulating Shoe Beam and Fuse Box.

We are still using the original cast steel shoes received with the equipment. It has been recommended that cast iron be used for this purpose, for the reason that in the event of a shoe catching a bracket it might tear the beam off or cause a derailment. Cast iron being the weaker it would probably result in nothing more serious than the loss of the shoe itself. It is but fair to add, however, that nothing of this kind has ever occurred in our experience.

An unusual incident occurred recently in connection with the third rail shoe. By a combination of circumstances a shoe picked up an iron barrel hoop which had found its way in a position where this was possible, causing a dead short between the shoe and track. Unfortunately this occurred near the 1200-volt sub-station and the violence of the short caused an armature coil to raise and foul with one of the pole pieces of the generator. This may have been caused by a poorly fitting slot stick which was forced out by the violence of the jolt. It is our judgment that horn fibre should be used in the slots of 1200-volt machines on account of its non-shrinking qualities.

The only external feature which distinguishes a 1200-volt motor generator from the ordinary type is the interpole arrangement. We have found it advisable to use a fibrous barrier to protect brush holders from the arc resulting from possible line shorts. In an emergency we have used a 1200-volt motor generator on a 550-volt circuit, but it is necessary to provide separate field excitation in that event.

Every part of the equipment, down to the smallest detail, is standard on each car as regards location. The bolt holes in the sub-frames are located by template securing uniformity in every car of the system for each portion of the apparatus. All the wiring is in loricated conduit, securing full protection from water and other deteriorating influences. Motor leads are encased in brass wire armor, but it is doubtful whether this is advisable. Unless carefully watched they sometimes chafe through the insulation, resulting in shorts of a most disagreeable kind. A good quality of rubber hose is preferable for this purpose and in my experience it has given the best results.

The motorman's cab located on the left side of each end is completely enclosed while the motorman is at his post. On the opposite end the door swings back against the controller and permits the full use of both sides of the platform for passengers entering or leaving car. In the motorman's cab within convenient reach are all the electrically operated switches required for the operation of the auxiliary equipment. They are all designed to be "fool proof" and there is no combination which can be worked by a motorman which will damage the equipment if improperly handled. The most serious result following improper handling will be stoppage of the car.

It will now be in order to discuss briefly the practical results obtained in the use of 1200 volts of direct current as compared with the older types of 550 or 600-volt motors. The first cost of a 1200-volt equipment is considerably more than the present standards of the same rated capacity. If, however, this type will perform the same duty at a lesser cost in power and maintenance it must certainly receive future consideration, but if such is not the case no inducement will secure its adoption. I do not consider 1200-volt motors adapted or necessary for ordinary street-car transportation. The present standards are entirely satisfactory and for various reasons voltages should be maintained as low as possible for the best interests of all concerned, particularly in the larger cities. For interurban service of any magnitude, say, roads of twenty-five miles or upwards in length the higher voltages can be employed with more satisfactory results.

The constructed portion of the Central California Traction Company is hardly of sufficient length to indicate the motor's efficiency, but with extensions planned there is every reason to believe that the results will amply justify the continued use of the 1200-volt equipment. We were given an excellent opportunity to make tests of the comparative efficiency of the G. E. 73 railway motor operating at 550 volts and the G. E. 205 at 1200 volts, both motors having the same rated capacity. Inasmuch as the latter was not fully developed when our road was otherwise ready for operation the General Electric Company furnished a temporary equipment of the G. E. 73 type which were new. A temporary sub-station was also furnished operating at 550 volts on the site of the future 1200-volt station. This combination furnished identical conditions except that the generators of the

Stockton sub-station operated in parallel with the interurban plant, which gave 550-volt operation every advantage.

Under the above conditions the power consumption per car mile for a period of six months averaged 5.23 kilowatt hours. With 1200-volt operation during the following six months our power consumption per car mile fell to an average of 4.74 kilowatt hours, a saving of 9.1% in power. Under existing conditions our 1200-volt generators are not working at the most efficient point. During fully one-third of the time the machines are without load, and during the remainder the load is hardly one-half the rated capacity of the machine. It is unnecessary to state that the best results cannot be expected under the circumstances outlined.

Power consumption is measured on the A. C. side of motor generators, therefore the above figures include not only generator, third rail and track losses, but power consumed at car. According to our records it requires about 150 amperes at 1200 volts to start and accelerate a given car, gradually dropping back to 70 amperes at full speed. The important factor in the use of 1200 volts, aside from that already stated, lies in the elimination of sub-stations in lines of considerable length.

The cost of operating a sub-station, exclusive of interest and fixed charges, is about $300 per month, and when once established this expense becomes practically a fixed charge itself. If, therefore, one sub-station operating at 1200 volts can be made to perform the same work ordinarily requiring two 550 or 600-volt stations and at the same time effect a saving of from 10% to 20% in power, it will best show what this new system is expected to accomplish.

The question of earnings per car mile is hardly under discussion at this time, but, as a matter of information touching upon the subject in general, during the year 1908 our earnings from passenger sources alone were 35.5c per car mile, with total operating expense of 14.0c per car mile. The cost of operation, exclusive of fixed charges, for the year amount to 38.4% of the gross earnings. This, you will understand, does not include freight and express service, which is handled and accounted for separately.

Our experience with 1200-volt operation has now covered a very hot summer followed by a wet winter, both of which have been extremes and of a character to test insulation to the fullest degree. Actual service conditions alone will mark the success or failure of an electrical equipment. The summer heat which varied from 90 to 105 degrees Fahr. for weeks was a hard test for this new equipment, yet to the best of our observation after a daily run of 200 miles or more every day in the week, the temperature of armatures and fields rarely exceeded 150 degrees Fah. At this living temperature insulation should stand almost indefinitely. It is safe to say that more trouble results from heating, overworking or overloading motors than everything else combined. This is directly the result of bad management and should not be laid at the door of the electrician. Whether it be a man or a machine, if persistently overworked the result is the same. Our experience during the winter has been equally satisfactory. It has been necessary at times to operate in places where tracks were covered with water to a depth of five or six inches. While ordinary prudence was observed under these conditions, no special precautions were taken other than to provide against wheel wash and to run slowly. Under both extremes the 1200-volt equipment has given less car failure than I have ever experienced during my connection with electric railway work. We have yet to lose a field, armature or other electrical part by a burn-out or any other cause.

I feel safe in saying that 1200 direct current operation has come to remain. It is no longer an experiment. There will doubtless be improvements of a minor nature, but I question whether direct current voltages will ever greatly exceed this point. The pioneer work has been accomplished and from a practical standpoint the results are certain.

TIMBER SEASONING AND WOOD PRESERVATION.

In recent years the importance of preserving timber from decay by the use of various antiseptics has been generally recognized in the United States. The value of properly seasoning timber before such treatment is not so generally known, though it is one of the most important features of the treatment.

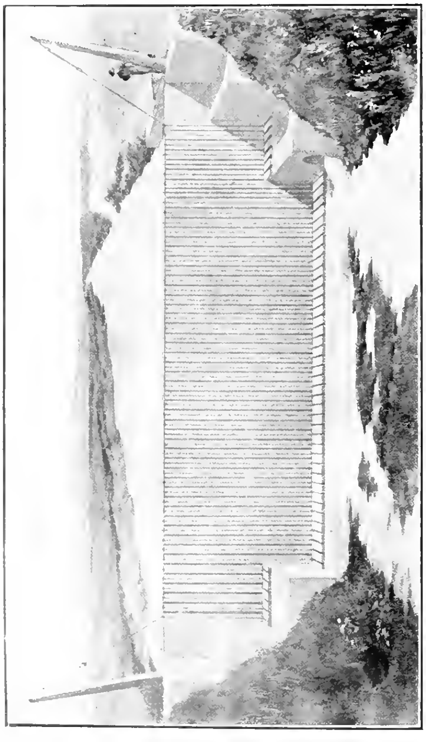
There are three main advantages to be derived from the proper seasoning of timber, namely: The increase in strength of the timber, the greater ease of injection of antiseptics for preserving the timber, and the saving in freight charges due to the decreased weight.

From thorough tests made by the Forest Service on various pieces of timber, it appears that thoroughly air-dry or seasoned timber has about double the strength of the green material. It is well known to all operators of wood-preserving plants that antiseptics are not only difficult to inject into green wood, but that it is practically impossible to obtain a uniformaly satisfactory treatment of such material at an economic cost, for the purpose of insuring a prolonged life.

The last item would at first seem too trifling to be worthy of discussion, but from data obtained only recently it appears that western yellow pine lost 50 per cent of its green weight after three to five months' seasoning. This means a saving of 50 per cent of the freight charges and a corresponding saving in the handling of the timber, and is therefore a far too important point to overlook.

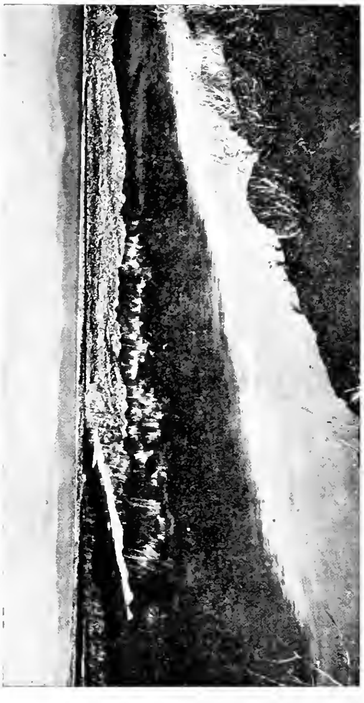
Considering these three points, it will be seen that there is not only a material saving in the seasoning of timber, but also a proportionate increase in the value of timber as a structural material. The seasoning of timber is never an expensive operation, even when done artificially. In the southern parts of the United States, a satisfactory degree of seasoning could be obtained by exposure of the timber to the air for a period of three to six months. In some of the Northern States, however, a somewhat longer period is necessary to secure satisfactory results.

A reinforced concrete yacht has been in commission for eleven years near Baltimore. The boat is a two-masted schooner, 65 feet long, 16 feet beam, and drawing 14 feet of water. It is particularly sea-worthy in a stiff breeze or heavy sea.



View of Dam and Canals from Below. (This View Shows the Needles Raised in Position and the Calking Timbers Inserted. The Head is 14 feet).

View Showing the Dam Cpen After the Needles Have Been Lowered.



Mocho or Main Line Drainage Canal in Winter.

Mocho or Main Line Drainage Canal in Summer.

NEEDLE DAM, PLEASANTON RECLAMATION PROJECT, CALIFORNIA.[1]

BY JAMES K. JAMES,
Assistant Engineer, Pleasanton Reclamation Project.

Within the last few months there has been constructed in connection with the Pleasanton Reclamation Project, California, a movable dam, which, though of moderate size, has several points of interest.

The Pleasanton Reclamation Project was organized to undertake the development of the Livermore Valley farm lands of the Alameda Sugar Company. The reclamation of about 5,000 acres has been accomplished by the construction of earth levees and canals to control and carry away the occasional floods. Up until 1906 the entire country thereabouts was partly under water at certain seasons and at all times of a marshy nature; but the efficient canal system now installed has turned it into one of the best drained and most fruitful large farms in the West. The reclaimed land sells at about $250 per acre.

A source of no small annoyance and expense in miantenance developed from the growth of aquatic vegetation in the canals during the summer months when the flow was small. To provide a remedy for this trouble it was proposed in 1907 to build a dam across the main line drainage canal in order that the water may be kept sufficiently deep in all parts of the channel during the dry season to completely drown out the vegetation. Incidentally, it was in recognition of the importance of creating a means by which the summer flow might be utilized, by allowing it to accumulate for such periods as would be necessary to collect a body of water large enough to be advantageously used for irrigation purposes. The new facilities provide for a storage supply of over 150 acre feet, which is held in the canal basins and may be drawn upon as occasion demands.

To comprehend clearly the significance of the particular design and construction adopted for this dam it would be best to consider briefly the works to which it has been added.

The canal works include seven miles of main line and five miles of tributaries. The drainage area supplying the canals is about 200 square miles, and the fluctuation between the dry and wet season flow is considerable. The main channel is designed to carry a maximum flow of 5,000 cubic feet per second. Briefly described, it has a bottom width of 34 feet; depth, 12 feet; grade, 1/8 of 1 per cent. The material excavated during its construction was thrown to either side, and levees built up from seven to eight feet above the level of the surrounding fields. A dam across the Mocho—main line canal—just below the junction of the Alamo and the Mocho, will back the water in each canal for a distance of several thousand feet.

The situation is unique, inasmuch as the canals are still subject to floods, provision for which is made by designing a movable type of dam, which may be, in case of sudden flood, immediately released, falling to a horizontal position on the floor of the canal and leaving an unobstructed course for the water. The head to be sustained is 16 feet. After the floods have subsided the dam is raised into position and the canals allowed to fill to the tops of the levees. The summer flow was increased by boring 12 artesian wells and leading them by underground tiles into the canals above the dam. Using a movable pumping plant (traction engines and 15-inch centrifugal pumps moved along the roads on the canal levees) it will be possible to irrigate the entire 5,000 acres. Gates inserted in the levees will also permit of gravity application at certain points.

Any variation in the summer flow may be regulated at the dam through a gate valve located in the walls, and by flash boards on the third level as shown in the illustration.

In choosing a type of movable dam the following conditions were considered: (1) A head of water of 16 feet to be sustained; (2) safety and ease of maneuvering in case of sudden and unexpected rises in the stream; (3) it should be maneuvered by the aid of the natural forces of the water course; (4) it should be sufficiently tight; (5) it should be composed of strong parts; (6) it should afford no obstacle when collapsed to the passage of floods; (7) it should be economical in regard to cost and operation; (8) scour to be guarded against below the dam; (9) no difficulty should be anticipated in lowering the dam on account of deposits of silt or sand on the floor.

Gates involving the principle of the bear-trap were found to be too costly, besides requiring considerable time to lower. The Chanoine wicket or shutter dams were also found to be expensive and the parts difficult to repair in case of accident. The Poiree Needles were subject to two objections: (1) The height was unfavorable to the use of needles; (2) continual watchfulness at certain times and danger of submersion. A type of dam was finally evolved answering the requirements and which was essentially a combination of the Chanoine wicket and the Poiree needle. It is in many respects a radical departure from dams of those types now in operation. The high head sustained is to be particularly noted. Among the salient features are: The substitution of steel channels for the wooden needles of the old type; the new method of holding the needles in place; the relative ease in lowering and raising and the low cost of construction.

Substructure—The foundation of the Needle dam consists of concrete masonry and imbedded and attached metalwork as shown by Figs. 1 and 2. Broadly speaking this work may be divided into (1) the abutments at each end of the dam, and (2) the foundation between the abutments.

Considering first the abutments it will be seen from Figs. 1 and 2 that each consists of 30 feet of concrete retaining wall. These walls have a height of sixteen feet and are carried up in two steps with horizontal offsets of six and four feet respectively. By stepping in the walls in this manner the canal section was closely adhered to. The change in section at the dam is therefore small and scour to the canal banks due to this cause is reduced to a minimum. Both the vertical and horizontal portions of the abutments are laid with 12 inches of concrete and reinforced with 1/4-inch round rods, 12 inches on centers which run continuous from top to bottom. The ends of the abutment walls turn into the bank at right angles with the direction of flow, and are carried back into the natural material to cut off water which might filter through the earth behind the abutments.

[1]California Journal of Technology.

The foundation between the abutments consists of a 12-inch floor slab. The concrete was laid directly on the hard clay bottom of the canal and reinforced both longitudinally and transversely with bars spaced 12 inches center to center. Along the upstream face canal was first carefully scraped and a firm bottom prepared for the floor slab by removing the overlying sand, gravel, and softer top parts till the firm hardpan was reached. The flow in the canal was carried over the work by means of a flume. The excavation for the

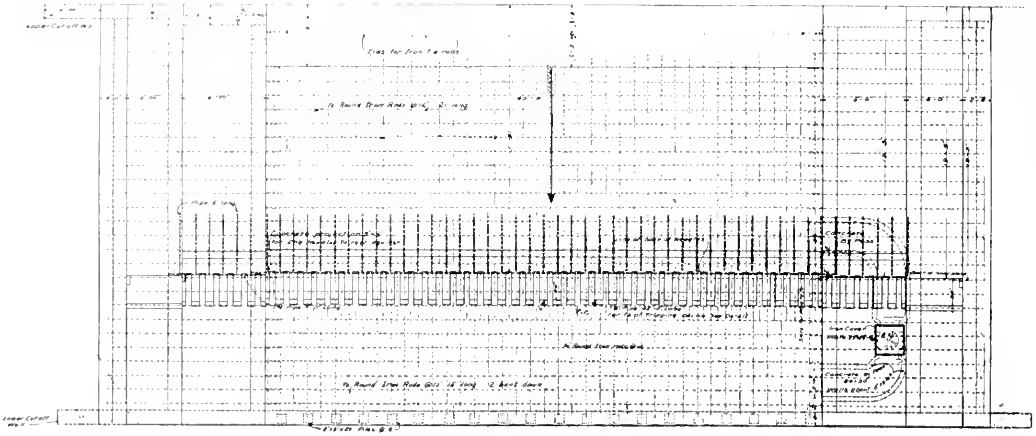


Figure 1. Foundation Plan.

a prismoid of concrete, $4\frac{1}{2}$ feet wide by 5 feet deep, forms an upper cut-off wall. Similarly a lower cut-off wall is provided along the downstream face, the dimensions of which are: $1\frac{1}{2}$ feet x 6 feet. This latter prismoid is imbedded in the tops of 8-inch x 8-inch piles, 20 feet long, 2 feet on centers and extending in a row the length of the dam. Figs. 1 and 3. The wing cut-off walls was then carried to the proper depth. By giving the bottom of each cut-off wall a slight slope towards the left abutment and locating a sump at each of these points to receive the suction hose leading to the pumps it was possible to keep the excavation entirely free from water. The seepage water was thus drained along the bottom of the cut-off wall

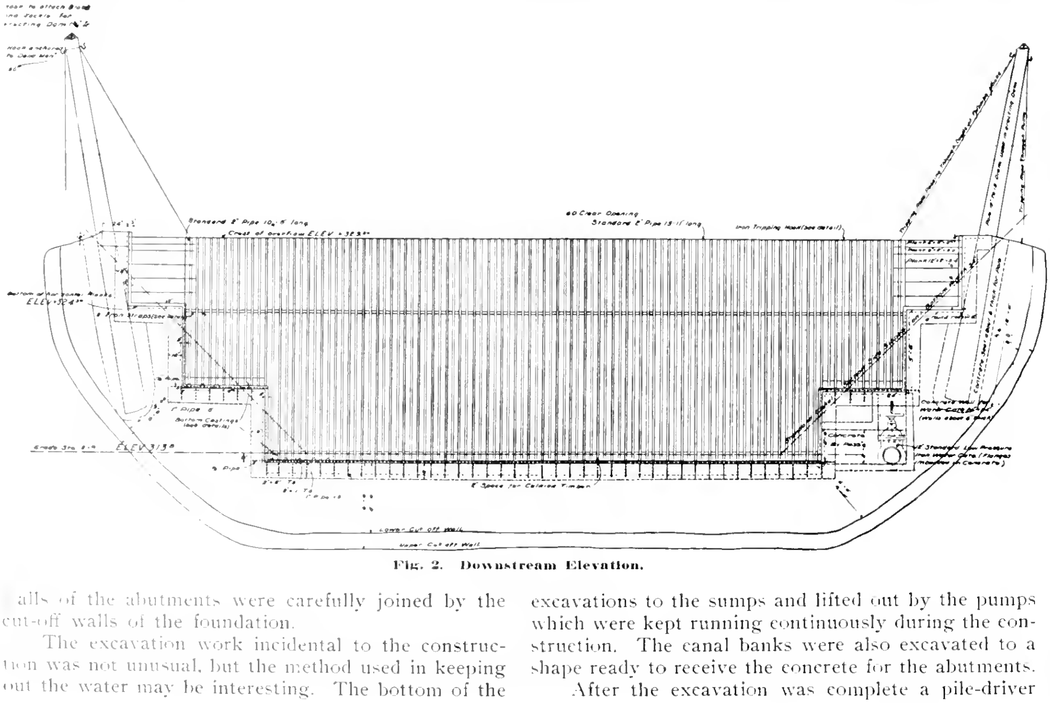


Fig. 2. Downstream Elevation.

walls of the abutments were carefully joined by the cut-off walls of the foundation.

The excavation work incidental to the construction was not unusual, but the method used in keeping out the water may be interesting. The bottom of the excavations to the sumps and lifted out by the pumps which were kept running continuously during the construction. The canal banks were also excavated to a shape ready to receive the concrete for the abutments.

After the excavation was complete a pile-driver

was lowered into position and the piles driven in a row along the lower toe. Nearly all the form lumber on the dam was used a number of times and a comparatively small amount was required. The offsets in the abutments afforded a support for the moulds for the upper portions of the walls and reduced greatly the number of timbers necessary for bracing. The forming and metalwork having been set in place, the entire substructure was concreted; working from the foot of the right abutment across the floor slab and upper and lower cut-off walls. The sump holes were the last part of the foundation to be filled with concrete, after which the abutments and wing walls were built up.

The concrete used in the floor slab and cut-off walls is a 1:2:4 mixture, and in the abutments the propositions are 1:3:6, the constituents being Santa Cruz

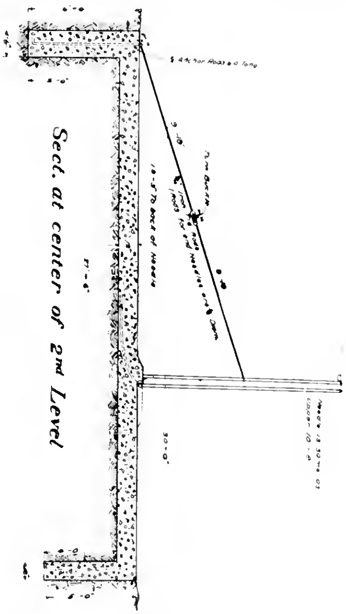


Fig. 4.

Portland cement, Monterey sand and screened crushed limestone that passes a 2-inch ring. The mixing was done by hand.

Foundation Metalwork—Upon the top of the floor slab, and built as a part of it, is a 3-inch x 36-inch sill. This sill extends the length of the dam along a line at about the two-third point from the upper toe. A 2-inch round iron rod traverses the center of the sill, and besides being imbedded in the concrete of the latter, is securely anchored at intervals of 12 inches by stringing on pipe T's into which tie pipes are screwed and bent down into the foundation masonry. This is indicated in Fig. 5.

Of the two vertical units of the dam proper, one, that on the downstream side, called the tripping device, is composed of 15-foot 10-inch length of extra heavy 2-inch pipe, which is provided at one end with a journal box enveloping the rod in the sill. These journal boxes of the tripping device are also pivoted on 12-inch centers along the rod and spaced midway between the anchors. The journals are essentially 2-inch x 2½-inch pipe T's; the body of which is strung about the rod, and into the collar is securely screwed the tripping pipe. To enable the journals and attached pipe to describe a quadrant about the rod as an axis and to allow the pipe to assume a horizontal position

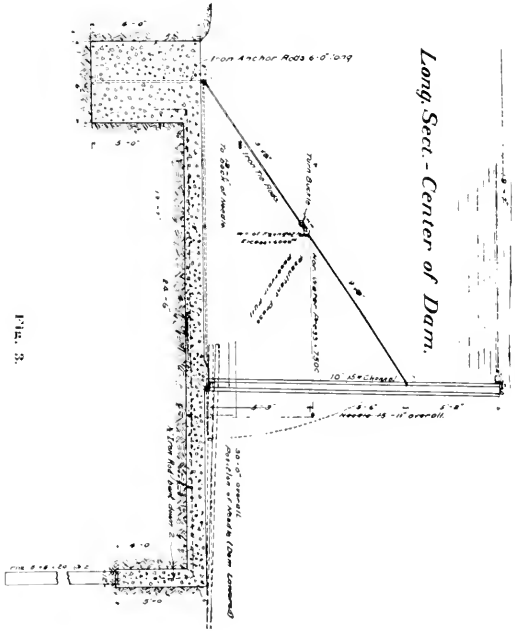


Fig. 3.

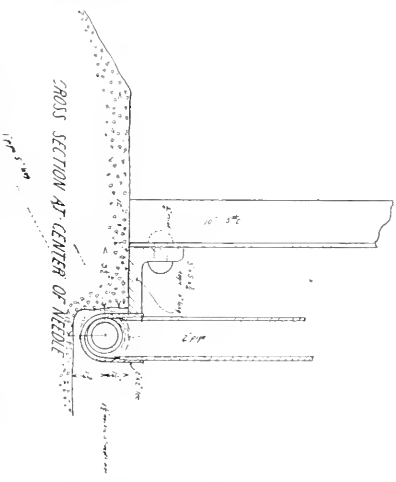


Fig. 5. Details of Tripping Device at Bottom of Needle.

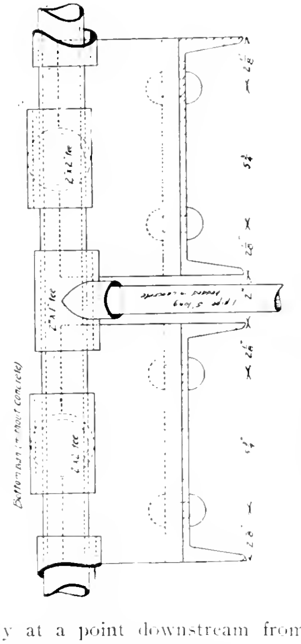
on the downstream floor when the daw is lowered, the sill has been slotted on the downstream face. These slots, moreover, serve as a guide to prevent adjoining pipes from fouling one another when falling to the floor (Fig. 7). That portion of the sill which is upstream from the rod, however, is made of solid section, for upon its face will rest the superstructure (Fig. 5). Details of the tripping device and pipes are shown by

Figs. (6) and (7) and need not be described further except to state that on the first step of the abutments they are similarly placed as on the main floor slab.

Iron Anchor Rods—½-inch anchor rods, 12 inches on centers, are built 6 feet into the masonry of the upper cut-off wall and extend in a line the length of the dam. The upper ends of these rods terminate in eyes which project 2 inches above the floor. Through the eyes an iron bar is strung, the purpose of which is to serve as a support and pivot for the inclined tension rods, forming a part of the superstructure and to be described later.

Concrete By-Pass—In order to regulate the flow when the dam is raised a concrete by-pass has been provided. The intake is in the abutment wall at the floor level and upstream from the line of needles. The passageway is 24 inches square and is operated by a 12-inch standard low-pressure iron water gate, whose flanges are imbedded in the concrete of the pass. The outlet is similarly situated in the abutment angle iron. These angle irons are cut the width of the channel and so fitted to the latter that the back of the projecting leg is flush with the end of the channel. A 3-inch semi-circular seat is scalloped out of the 5-inch projecting leg as shown by Fig. 8. Two-thirds of the height of the needle from the angle iron is fastened a standard U-bolt, as shown by Fig. 9, into which fits the eye of a ¾-inch round tie rod. The head of the U-bolt projects from the inside of the channel web, between the flanges. Each tie is composed of two 9-foot 10-inch lengths joined by means of a turnbuckle to allow any adjustment in length. The two free ends terminate in eyes, one of which fits into the U-bolt on the channel. The other eye is pivoted about the horizontal bar which traverses the floor of the dam on a line above the upper cut-off wall. (Figs. 3 and 4.)

When the channel is raised the U-bolt forms the axis of rotation for the eye of the tie rod. The tie assumes an angle of about 45 degrees as the channel becomes vertical. At this point the long 2-inch pipe of



BOTTOM PLAN (without concrete)

Fig. 6. Details of Tripping Device at Bottom of Needle.

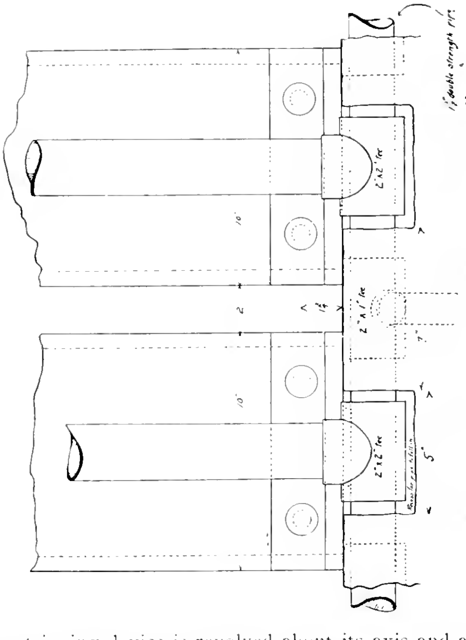


Fig. 7. Details of Tripping Device at Bottom of Needle.

wall, only at a point downstream from the line of needles. Figs. 1 and 2.

Poles to Facilitate Erection of Dam—Fir poles have been imbedded in the concrete of the abutments, one on each side and located slightly downstream from the line of needles. The tops of these poles are provided with iron hooks between which a cableway may be strung (Fig. 2).

The foregoing cover the principal parts of the foundation metalwork.

Superstructure—The movable dam proper is secured to the foundation thus prepared. A unit of this Needle dam consists of these essential parts:

A needle which is a 10-inch, 15-pound steel channel. These channels are 15 feet, 11 inches in length. Riveted to the outside of the web at one extremity is the 3-inch leg of a 5-inch x 3-inch x ¾-inch standard the tripping device is revolved about its axis and also swung up to a vertical position. The bottom of the channel is forced slightly downstream by the water pressure until the semi-circular seat arranged on the projecting angle leg engages about the journal box at the foot of the tripping pipe. The pipe and the channel are the same length, so when both are vertical the tops coincide and may be fastened together by a hook (Fig. 4). The channels are thus supported at the bottom by resting on the sill and bearing against the journal boxes of the tripping device. At the top they are held by the inclined tie rods. When the dam is filled with water the needles and tripping pipe have a slight downstream batter, so to lower the dam it is only necessary to remove the hook joining the top of the needle with the top of the pipe to cause the latter to overturn and swing into its respective slot in the

floor slab. The needle now has no support against the water pressure at the sill and the bottom slides downstream till the whole needle finally falls into position on the floor. The needles when down lie below or downstream from the sill; therefore are protected by it. The sill, in turn, is as low as the canal bottom above and below the dam; hence offers no obstruction to the flow of water.

The dam is formed by a series of these needles, extending across the canal, each unit being independent of its neighbor. The needles are 10 inches wide and spaced 12 inches on centers, leaving a 2-inch space between adjacent members. This prevents needles hitting one another during maneuvers. V-shaped calking timbers may be inserted in these spaces to make the dam watertight.

To Raise the Needles—Between the two poles projecting upwards from the abutments a cableway is stretched. By means of a trolley the hoisting sheave is then shifted across the cableway to a position above the needle to be raised. Over the sheave passes a chain having a hook at its free end. At the top of each needle is a handle. By placing the chain hook in this handle and pulling on the free end of the chain the needle is raised from the floor. After being raised nearly into position, it is left suspended. By a similar arrangement the tripping pipe is raised, caution being exercised to engage it into the semi-circular seat in the angle iron at the bottom of the needle. The pipe is then closed up to the needle and the two hooked together at the top. This operation is repeated till the 52 needles composing the dam are all raised.

The upstream arm of each tripping hook is extended several inches beyond the flanges of the channels and the projecting arm bent with a lip. A timber float is run transversely the length of the dam, directly under these lips of the tripping hooks. The buoyancy of the water will always keep the float at its surface and it is so arranged that when the water reaches nearly to the top of the dam the floats lift the hooks sufficiently to disengage the tripping pipes and the channels. This construction is best illustrated by Fig. 10. The pipes then swing downstream and are followed by the needles.

The experience thus far gained with this dam indicates that its operation will be speedy and sure, although it has not as yet had sufficient trial to demonstrate how it will behave under all conditions or what unthought-of difficulties may arise.

Cost—Under favorable conditions a dam of this type may be erected for $100 per lineal foot of dam.

Attention is called to the advantageous distribution of stresses in this special design.

Considering the dam as a whole the following calculations will show that the lines of resultant pressure lie within the center third of the profile.

Taking moments of area about lower toe. Fig. 11.

	Area		Lever Arm		Moment
Upper cut-off wall	(27)	X	(27.75)	—	749
Foundation slab	(25.5)	X	(12.75)	=	325
Lower cut-off wall	(4)	X	(.5)	=	2
Total section	56.5				1076

Distance of center of gravity from lower toe = 1076 ÷ 56.5 = 19.08.

Assuming the weight of a cu. ft. of concrete in water to be 90 lbs., the excess weight of 1 lineal foot of the foundation will be:

90 lbs. x 56.5 = 5085 lbs. (1)

which acts through its center of gravity.

When the needles are up, the resultant of the pressures which they sustained may be expressed as

$$\text{Resultant Pressure} = \frac{(15.5)\ (62.5)\ (15.5)}{2} = 7508 \text{ lbs.} \qquad (2)$$

This discussion is limited to a consideration of the hydrostatic pressures when the dam is full; moreover, the downstream batter to the needles has been neglected, as the deviation from the vertical is very slight.

The point of application of this resultant is 2-3 the depth of the needle.

Combining (1) and (2) it is shown in Fig. 11 that their resultant cuts within the middle third of the foundation profile.

It should be clear since the needles are supported at the bottom and at the 2/3 point that the two reactions will each be:

$$\frac{7508}{2} \text{ lbs.} = 3754 \text{ lbs.}$$

The resultant pressure sustained by the needles is thus resolved into two parallel and equal components, of which one is overcome by the resistance of the rod imbedded in the sill, and the other acts through the U-bolt and forms the horizontal component of the stress in the inclined tie rod.

The position adopted for the line of needles resulted from the following considerations, in which an endeavor was made to eliminate any tendency towards bending in the floor slab by inclining the tie rods at such an angle that the vertical component of their stress will just equal or be less than the weight of the concrete in the upper cut-off wall.

Referring again to Fig. 11.

The weight of 1 lineal foot of upper cut-off wall will be: 90 lbs. X 27 — 2430 lbs.

To make V = weight of upper block = 2430 lbs. (No bending in floor slab.)

$$V = H : \tan\angle = \frac{H}{x \quad y} = \frac{Hy}{x}$$

$$\text{or } x = \frac{Hy}{V} = \frac{(3754)\ (10.667)}{2430} = 16.5$$

$$T = H \div \sin\angle$$
$$= 4470 \text{ lbs.}$$

Theoretical deductions for maximum bending moment, needles fixed at bottom and 2/3 point.

Referring to the pressure diagram (Fig. 12).

Let $R_1 = R_2$ — reactions at bottom and 2/3 point.

Mx = bending moment at any section x distant from the bottom.

h = length of needle.

a = constant = 62.5 = wt. of cu. ft. water.

x = distance from bottom to any section.

Pc — resultant pressure on cantilever portion.

Also as shown in the diagram the total pressure between any section x and the bottom may be represented by Pr and Pt,

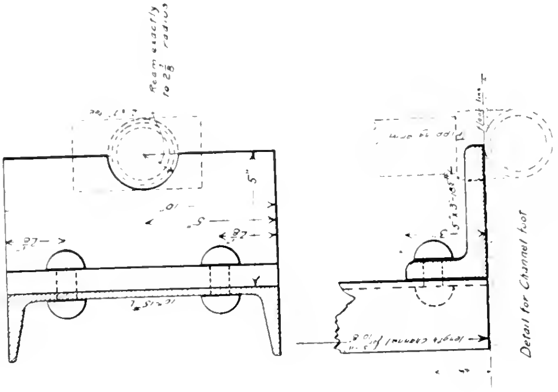


Fig. 8.

Fig. 12. Pressure Diagram.

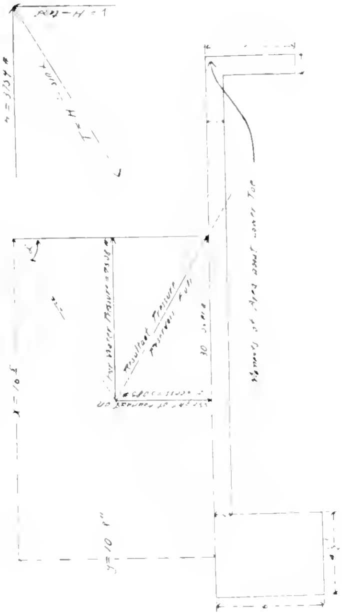
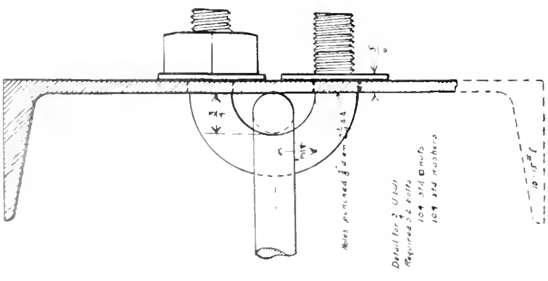


Fig. 11.



Details of Iron Work.

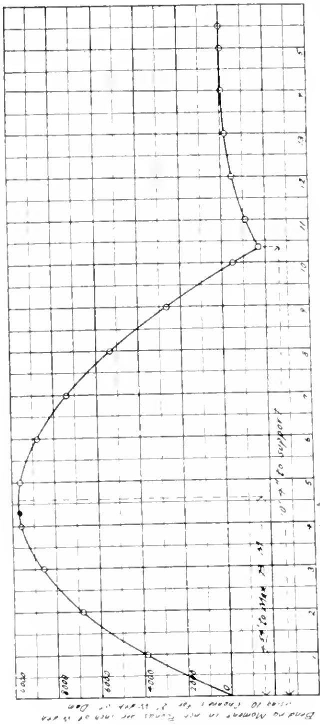


Fig. 13. Bending Moment Diagram.

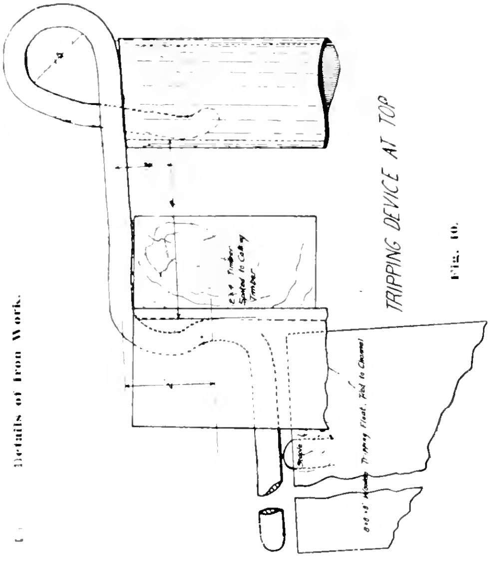


Fig. 10.

Whence, the moment—

$$Mx = R_2x \frac{2x}{3} Pt - - Pr \frac{x}{2}$$

$$= \frac{a\,h^2x}{4} \left(\frac{ax^2}{2}\right)\frac{2x}{3} - ax\left(h - x\right)\frac{x}{2}$$

$$= \frac{a\,h^2x}{4} - \frac{ax^3}{3} - \frac{ax^2h}{2} + \frac{ax^3}{2}$$

$$= \frac{a\,h^2x}{4} - \frac{ax^2h}{2} + \frac{ax^3}{6}$$

$$= \frac{a}{12}\left(3h^2x - 6x^2h + 2x^3\right) \ldots\ldots\ldots\ldots (1)$$

To get value of x for maximum M.

$$\frac{dM}{dx} = \frac{a}{12}\left(3h^2 - 12\,hx + 6x^2\right) = 0$$

$$\text{or } 2x^2 - 4\,hx + h^2 = 0$$

WHENCE:

$$x = \frac{4h}{4} \pm \left(\sqrt{\frac{16h^2 - 8h^2}{4}}\right)$$

$$x = .293\,h \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Substituting this value of x in the general expression for bending moment we have:

$$M\ max. = \frac{62.5}{12}\left(.879\,h^3 - .514\,^3 + .050\,h^3\right)$$

$$2.16\,h^3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Considering the cantilever portion of the needle.

$$M\ max = \left(\frac{ah^2}{18}\right)\left(\frac{h}{9}\right)$$

$$= .376\,h^3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (4)$$

$$Mx = 12.5\,(x - h)^3 \ldots\ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Fig. 13 is a bending moment diagram in which the B. M. is expressed in inch pounds per inch in width, using 10-inch channels for 12-inch width of dam. The B. M. in inch pounds per inch of width = 1.2 B. M. in foot pounds per foot of width.

The diagram was calculated from the following formulae:

B. M. = $6.25\,(3h^2x - 6x^2h + 2x^3)$: below 2/3 point.

B. M. = $12.5\,(x - h)^3$ above 2/3 point.

Substituting the value of h = 15.5 and x = 4.54.

M max = 9660

If the greatest intensity of fibre stress be taken at 10,000 pounds per sq. inch = k

$$\text{then } \frac{M}{k} = \frac{9660}{10000} = .96 = \text{section modulus.}$$

As the section modulus of a 10-inch, 15-lb. channel is = 1.17, that size channel fulfills the requirements.

The dam was designed by Messrs. F. H. Tibbetts and P. A. Haviland, engineers in charge of the Pleasanton Reclamation Project. The erection was done under the supervision of Mr. Tibbetts, who was represented in the field by the writer.

Officers of the Alameda Sugar Company are: John L. Howard, president; E. C. Burr, vice-president and general manager. The offices of the company are in the Hansford Building, San Francisco, Cal.

The contractors for the foundation and imbedded metalwork were the E. B. & A. L. Stone Co., Elmhurst, Cal., of which Mr. D. U. Toffelmier is superintendent.

CURRENT COMMENT.

Coffee roasting by electric heat is one of the latest industrial applications of electricity.

The first electric steel furnace in Belgium has been started by the Cockerill Company of Seraing.

Single-phase traction is recommended in a report prepared in the Swedish State Railways by R. Dahlunder as best adapted to Swedish conditions. He also favors 25 cycles.

Gas for oxyhydrogen flame may be obtained by electrolytically decomposing acidulated water, pure water not supplying a large enough proportion of hydrogen. This method has not yet proven commercially practical.

Hydrogen from water gas may be obtained by passing the gas through a receptacle filled with inert material over which cuprous chloride trickles. The carbon monoxide is dissolved in the cuprous chloride and practically pure hydrogen is liberated. The carbon monoxide is afterwards extracted by pumping in vacuum and burned under the gas generator.

The first English single-phase electrification of an existing steam road is that of a ten mile double track section of the Midland Railway, between Heysham, Morecambe and Lancaster. Alternating current will be used at 6,600 volts, 25 cycles. A nine mile double track section of the London, Brighton and South Coast section is also being furnished with overhead electric transmission.

Nominations for the A. I. E. E. election in May are as follows: President, Mr. L. B. Stillwell, New York City; vice presidents, Messrs. J. J. Carty, New York City; Paul M. Lincoln, Pittsburg; Paul Spencer, Philadelphia. Managers, Messrs. A. W. Berresford, Milwaukee; W. S. Murray, New Haven; H. H. Norris, Ithaca; S. D. Sprong, New York. Treasurer, Mr. George A. Hamilton, New York City. Secretary, Mr. Ralph W. Pope, New York City.

Examination for Assistant Physicist is announced by the United States Civil Service Commission, on April 21, 1909, to fill ten or more vacancies in the positions of laboratory assistant (in physics) and assistant physicist in the Bureau of Standards, at salaries varying from $900 to $1,200 per annum for laboratory assistant, and from $1,400 to $1,800 per annum for assistant physicist, and vacancies requiring similar qualifications as they may occur.

Utilization of atmospheric nitrogen is accomplished by a new process devised by the Westdeutsche Thomas Phosphat Werke of Berlin. Electric discharges in exploding a mixture of air and hydrogen produce a rapid temperature rise, which forms peroxide of nitrogen. At ordinary temperature this is a gas which unites with water to form nitric and nitrous acid. At thirty degrees below zero it is a crystalline solid. A combustible vapor or gas, such as ether, may be substituted for hydrogen, or the same temperature rise followed by sudden cooling may be obtained by blowing powdered calcium peroxide into an electric arc, producing calcium nitrate.

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Another Pioneer.

New conditions in a new country require new methods. This has been exemplified in the West, not only by radical departures from established precedent in mining and agriculture, but also in power production and utilization. Foremost in originality has been the pioneer work in long distance transmission of hydro-electric power. In the same list should be included the impulse water wheel, the cable railway of Hallidie, the oil-water-gas process of Lowe, and successful fuel oil burning. Recently, there is the 1200-volt direct-current railway.

Such a road between Stockton and Lodi in California is said to be the first in this country. An article on its operation by Mr. S. B. McClenegan is interesting, not so much for its comparative data, as it is for its descriptive and suggestive details. The motors, which are of the commutating pole type, operate under 1200 volts. Direct current is supplied by a third rail. The equipment has been designed for a much greater mileage than has yet been completed and consequently the power factor is too low to be used as a basis for comparing the economy of this with that of other systems.

The 1200-volt railroad is the direct result of the demand for higher voltages for interurban work. While it is admitted that the low voltages in use for city traction are eminently satisfactory, it must also be allowed that for interurban service, involving long distances, the cost of frequent sub-stations becomes prohibitive. By doubling the voltage the same power can be transmitted four times as far with equal economy. Other factors bring down this ratio so that with double the voltage half the number of sub-stations is required.

It is still too early to institute comparisons between this and the single-phase or three-phase alternating current systems. Each has obvious advantages for certain kinds of service, but no one is of universal application. Every discussion of their relative merits involves the improbable, ubiquitous "if." Whistler, the artist, in referring to his failure to pass the West Point examinations, said: "If silicon was a gas I would have been a major-general by this time." If conditions were such and so, the other systems might give better results. Existing conditions have been well met by some one of these systems and it seems fruitless to discuss a matter whose possibilities are not fully developed. Far better it is to admire the courage and the persistence of those who are not only blazing the trail, but also removing many of the obstacles, so that the way will be easy for those who follow.

CURRENT COMMENT

Canadian electric railways constructed 33 miles of track during 1908, as compared with 72 miles during 1907.

Electrification of Italian railways is to be started in several sections by the Italian railroad commission under an appropriation of seven million dollars.

Electrification of steam railroads was discussed by the New York Railroad Club on March 19. Dr. William McClellan outlined the development of electric railways and systems. The discussion that followed showed the superiority of electric traction.

The electric locomotives of the Great Northern Railroad are the most powerful locomotives in existence, each utilizing two thousand horse-power three-phase electric current. The Westinghouse Company is designing a 2,750 h. p. single-phase locomotive.

A new mantle for incandescent gas lighting will soon be on the market. It is claimed that these mantles will burn one thousand hours without appreciable loss of efficiency and are strong enough mechanically to submit to collapse with impunity after being burned off.

"Economy coils" are small transformers that lower a high-voltage current so that low-voltage tungsten lamps may be used. It will probably be but a short time before these become of commercial value, as the tungsten filament is not so fragile if made for low voltage.

A water supply for Manila has been obtained from the Mariquina River, twenty miles north-east of the town. The watershed covers 140 square miles and the installation includes 10½ miles of 42 inch steel pipe and 4½ miles of concrete tunnel. A reservoir capable of holding fifty million gallons has been built and the plant has a capacity of twenty-two million, five hundred thousand gallons daily.

The transformer as a funnel is learnedly explained in a recent issue of the "Saturday Evening Post." "The electricity is furnished by the generator in varying quantities—sometimes more, sometimes less. But the transformer acts like a funnel, the current coming out of it always in a stream of a certain size. This, of course, is a matter of utmost importance, inasmuch as the electric 'fluid' could not be utilized satisfactorily for lighting, for running machinery, or for any other purpose, if the quantity of it delivered were constantly varying."

Mercury makes meters run slow according to experiments made by Herr J. Busch as described in the Electro technische Zeitschrift. A motor meter which had been running satisfactorily on a 110-volt circuit, 10 amperes normal load was 5 per cent, 15.3 per cent and 21.6 per cent slow at full load, half load and tenth load respectively, four days after a small piece of amalgated brass had been placed in it. This error increased with time and is due to a deposit of mercury in the commutator. The experiments show the bad effects of mercury near such meters.

PERSONALS.

S. K. Colby, treasurer of Pierson, Roeding & Company of San Francisco is in Portland.

A. D. Skinner, sales engineer for the Skinner Engine Company of Erie, Pa., is in San Francisco.

John D. Sutton, electrical contractor of San Francisco, accompanied by Mrs. Sutton, sailed for Vancouver this week to look after some contracts he has there.

A. B. Vandercook of the San Francisco office of the Telephone-Electric Equipment Company has returned from a very successful two weeks' business trip to Los Angeles.

J. H. Klinck, representing the industrial and power department of the Westinghouse Electric & Manufacturing Company, has returned to San Francisco from Seattle on his way to Pittsburg.

Albert Schuler, formerly connected with the Chicago office of the Stromberg-Carlson Telephone Manufacturing Company as telephone engineer, has taken charge of the telephone department of the Telephone-Electric Equipment Company, who represent the Stromberg-Carlson Company on the Pacific Coast.

NEWS OF THE STEAM ENGINEERS

San Francisco No. 1, N. A. S. E., will hold a called meeting next Thursday evening, April 1st, to take action looking to their affiliation with the California State Association, N. A. S. E.

The meeting of April 8th will be entertained by a lecture on air lift pumps, by Mr. Sam Skelly of Alameda.

A. T. PERRY, Secretary.

HOW TO LIGHT RAILWAY CARS.

A comparision of the different ways of lighting railway trains by electricity, showing the advantages and defects of each method, has just been published in a bulletin entitled "Investigation of Methods of Railway Train Lighting," in the engineering series of the University of Wisconsin. The author, Edward Wray, received his degree of electrical engineer at the university in 1906.

After tracing the advance of lighting methods in railway cars from the single candle used in English coaches in 1825, through early experiments with oil lamps and adapations of all the various methods used in lighting streets and houses, Mr. Wray describes the storage battery equipments, steam driven generators in baggage cars, and axle generating equipment in individual cars.

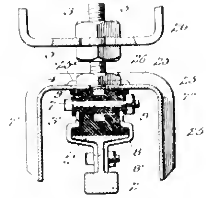
"It is impossible to make a sweeping claim of superiority for any one type of equipment," says the author. "Each is more or less applicable to certain kinds of service. The success of any of the types of lighting equipment lies largely in the hands of the railway operating department. The simplest of all the electrical equipments is undoubtedly the straight storage equipment." Storage batteries, however, must be charged each day, the bulletin points out requiring expensive charging stations at terminals, and making this mode of lighting impractical for long overland runs. For short runs with heavy traffic and a large number of cars, the storage battery is most economically operated.

Steam-driven generators are also comparatively simple, but require an attendant, and demand that the train be a unit, not allowing any car to be introduced which has not that system of wiring. Thus they are most applicable to trunk line trains with a definite run, especially overland trains.

For a large number of cars the only suitable method of lighting by electricity is that in which the power is generated by the axle of the car, says the author. Though the machinery is complicated, and gets out of order easily, necessitating constant attention, it is one which makes each car an independent unit, so that it may be used either in block trains or on miscellaneous runs.

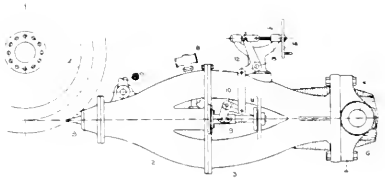
PATENTS

915,375. Insulating third-rail support. Daniel M. Pfautz and John L. Luckenbach, Philadelphia, Pa., assignors to The American Suspension Railway Company, Philadelphia, Pa. In a third-rail support, a depending third-rail; opposed hanger-plates each having a portion contacting with the web of the



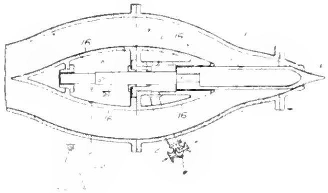
rail and bolted thereto, a portion outwardly bent contacting with the base of the rail, and an upwardly projecting portion; an insulating block with which said upwardly projecting portion engages and to which it is bolted; and means for supporting the insulating block from the elevated structure.

915,277. Water-wheel nozzle. George F. De Wein, Milwaukee, Wis., assignor to Allis-Chalmers Company, Milwaukee, Wis. A curved passage, pivoted nozzle having the center line of its discharge and the center line of its inlet coincident and



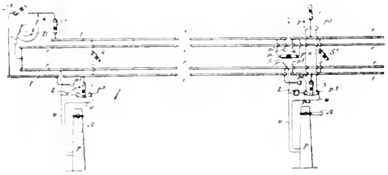
said coincident center lines intersecting the axis of the pivot bearing, and means for throttling extending outside of the nozzle and having the outside portion located adjacent the concave side of the curved portion of the nozzle.

915,214. Nozzle. Arnold Pfau, Milwaukee, Wis., assignor to Allis-Chalmers Company, Milwaukee, Wis. The combination with a curved-passage nozzle having an aperature, of a needle extended through the curved walls of said nozzle and having the outer portion located adjacent the concave side



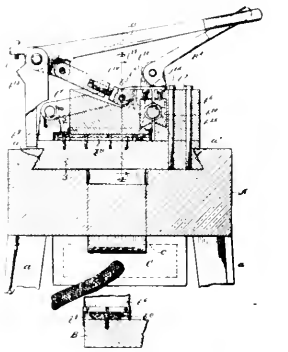
of the curved portion of the nozzle and directly accessible from without the nozzle walls and adapted to control the thoroughfare through said aperature, the space between the portion of the needle within the nozzle and the opposite walls of the nozzle being symmetrically enveloped about said needle portion.

915,189. Safety system for electric railways. Charles J. Kintner, New York, N. Y. In a railway system a continuous third rail or contacting conductor connected to a source of electrical energy; a switching device carried by each car or train for automatically disconnecting the motor thereof from the source of power which drives it; in combination with semaphore arms located at intervals beside the track for automatically actuating said switching devices; together with electromotive devices for operating said semaphore arms,



said electromotive devices being included in circuit with sectional third rails or conductors parallel with the track and each car or train provided with means for cross connecting said sectional conductors successively to the continuous third rail or contacting conductor, the arrangement being such that when a car or train is passing over a given section of the road any car or train immediately following the same will be automatically stopped, should it approach too closely to the first-named car or train.

915,249. Apparatus for welding by electricity. Charles E. Thompson, Cleveland, Ohio, assignor, by mesne assignments, to The Electric Welding Products Company, Cleveland, Ohio. In apparatus of the class described, an electrode comprising a base plate forming one terminal of the heating electric circuit, a block fixedly mounted upon said plate, a



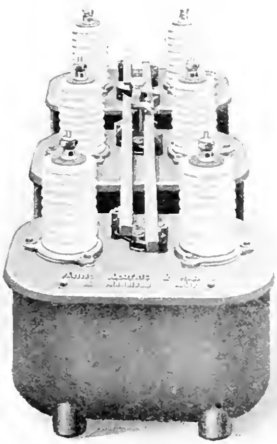
second block mounted upon said plate so as to be moveable in a direction transverse with respect to the direction of movement of the latter, and clamping dies removably secured upon the contiguous faces of the respective blocks, said dies being formed to substantially encompass one of the parts to be joined, and both said blocks having approximately equally direct electrical connection with said last named electrode, whereby a uniform distribution of current is had in such part, substantially as described.

INDUSTRIAL

PACIFIC ELECTRIC & MANUFACTURING COMPANY.

The Pacific Electric & Manufacturing Company, which has been engaged in the manufacture of oil switches, circuit breakers and pole-top line switches for handling power lines at high voltages, have recently moved their factory from Napa to a new building at 80 Tehama street, San Francisco. With this move they have greatly increased their facilities for turning out switches and developing the new models for the higher voltages now coming into use and for working up the various control systems demanded by modern practice.

They have recently developed an excellent little 33,000 volt switch, which is a modification of their well-known 60,000

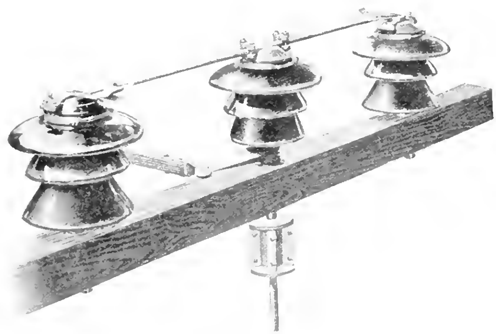


33,000 Volt Switch.

and 80,000 volt type, a cut of which is shown below. The features that will appeal to the engineer in this switch are that the tank is of cast iron in one piece, obviating the possibilities of leaking or dripping, which are always present with wood, fibre or sheet-metal tanks. There are no wood parts in the oil, and the current is carried by a one-piece, cast brass, moving contact, doing away with the necessity of any links, hinges or complicated motions; the contact clips are rigidly alligned and all the contact parts are readily and quickly removable, and the parts, made to standard forms, can be replaced by loosening a readily accessible nut. All parts of the switch are suspended from and firmly held in the cast-iron tank cover and can be lifted clear of the oil without emptying the switch or lifting any submerged frame or supports. The control is so arranged that the switch cannot be left partly closed, and all switches of this type can be fitted with an automatic trip at any time after the switch is in place. The porcelain is not under tensile strain, is ample in cross section, has large creepage surface and is held in long, cemented bearing surfaces, eliminating the possibility of electrical or mechanical trouble.

The switch can be furnished with ground insulators if required and with a remote electrical control The contact buttons for the control are enclosed in a cast-brass case, which is fastened to the front of the board so that it is not necessary to drill the marble of a switch-board for lamps or control levers, everything but the control-wire lead-outs being encased in this box.

The pole-top switch also shown on this page is the well-known type developed for Pacific Coast use, and is now installed on many of the large transmission systems in the West. It is of simple construction and so arranged that all the contacts can be opened simultaneously from the ground; the details have been worked out in such a way that the switch will not stick or bind even after long exposure to the weather. This company has now been engaged for over two years in switch construction and has met with considerable success in this special field.



Pole Top Switch.

NOTABLE ADDITION TO HEALD'S COLLEGE.

Thomas J. Kirk, ex-Superintendent of Public Instruction of California, is now vice-president of Heald's Business College, of San Francisco, with branches in a number of California's towns. Besides the regular business college, instruction is also given in mining, electrical, mechanical, civil, steam, gas and automobile engineering.

TRADE CATALOGUES.

The Pelton Water Wheel Company, of San Francisco and New York, have issued the eleventh edition of their catalogue on the Pelton Water Wheel. This is the most artistic and comprehensive catalogue yet issued on this subject. The numerous illustrations, whether of scenes, apparatus, methods or installation, are of the highest class, as are also the typography, press work and binding. The 116 pages of this catalogue contain more of interest and value than is found in the usual text book on hydraulics. In addition to the impulse wheel, for the first time is illustrated and described the Pelton-Francis turbine, as well as governors, gate valves, pipe and all accessories appertaining to water power installations.

TRADE NOTE.

The electrical trade generally, will be interested in knowing that the cross-arm business of the Walworth & Neville Manufacturing Company, pioneers in the cross-arm business, was, under date of March 1st, transferred to a new corporation, the American Cross-Arm Company, who have taken over the entire business of the old company and will continue in the old offices of that company in the Heyworth Building, Chicago. Mr W. M. Carpenter, President, and Mr. A. F. Crosby, sales manager, continue in charge of the business.

NEWS NOTES

TRANSPORTATION.

LOS ANGELES, CAL.—Bids will be received till April 26th for the sale of a street railway franchise on certain streets in this city.

MODESTO, CAL.—The San Joaquin Valley Electric Railroad Company has purchased a franchise on Ninth street in this city.

SAN MATEO, CAL.—E. M. Warn has applied to the City Trustees for a franchise to construct an electric line from this city to the beach.

LOS ANGELES, CAL.—The Los Angeles Railway Company has been granted a 21-year franchise to operate an electric line on certain rights-of-way in this city.

ASTORIA, ORE.—Council has passed an ordinance granting a 30-year franchise to the Oregon Coast Railway for the construction of an electric railway over certain streets.

VALLEJO, CAL.—City has received an application from Randall, Wright & Trowbridge of Oakland for a franchise for an electric road to White Sulphur Springs and Benicia.

PORTLAND, ORE.—The Portland Railway, Light & Power Company has petitioned for a 30-year franchise to extend its lines through Fairview to connect with the O. R. & N. steam line.

NORTH BEND, ORE.—The Coos Bay Electric Company has petitioned for a 30-year franchise to construct an electric line from Marshfield to North Bend—S. H. Bell, Representative.

BOZEMAN, MONT.—The contract for the construction of a 20-mile electric railway between Bozeman and Salesville has been awarded to Westinghouse-Church-Kerr Company of New York.

ANACONDA, MONT.—The construction of an electric railway from Anaconda to Hamilton is under consideration. The road will be about 60 miles long. A. M. Walker, Anaconda, is reported to be interested.

OAKLAND, CAL.—The San Francisco, Oakland & San Jose Railway Company has been granted a franchise to construct standard-guage lines on certain thoroughfares in this city. Beginning April 11 a new service over the Fifty-fifth street line is to begin.

PLUM, WASH.—Seattle Capitalists have organized a company for the purpose of building an electric line from Plum, Wash., on the Columbia river, to Coulee City; distance 50 miles. A power sight at Monoghan Rapids, about 12 miles from Plum, will be developed.

VALLEJO, CAL.—Manager McIntyre and Attorney John T. York of the Napa Valley electric road have conferred with the Board of City Trustees in reference to the new franchise sought by the company to build a loop line through the eastern section of the city and also to secure permission to cut the grade of Sonoma street.

TACOMA, WASH.—The Thunder Creek Transportation & Smelting Company has been incorporated by A. M. Richards, W. W. Shenk, F. S. Blattner of Tacoma, Chas. E. Phoenix of Bellingham, and George Senior of Seattle with a capitalization of $3,000,000 to build an electric or steam railway and a telephone and telegraph line along Thunder creek in Whatcom and Skagit counties.

FRESNO, CAL.—Engineering work has been started for the proposed Fresno-Hanford interurban line, and it is expected that active construction work will be started by April 1. All construction work will be done from Fresno end of the line. F. S. Granger, Hughes Block, Fresno, is promoter of the line. The road is financed by the Cleveland Construction Company, W. E. Davis, President, Cleveland, O.

FRESNO, CAL.—Bonds amounting to $1,000,000 for the proposed Fresno-Hanford Interurban Railroad will be purchased by the Cleveland Construction Company. Grading on the new road begins on April 1st. Vice President and Chief Engineer W. E. Davis of the Eastern company is expected to arrive about April 1st. He will supervise all of the work of construction.

OAKLAND, CAL.—The February statement of the San Francisco, Oakland & San Jose Railway Company compares with February, 1908, as follows:

	1909.	1908.
Gross earnings	$68,590 51	$68,407 38
Operating expenses	33,151 45	35,463 95
Net earnings	$35,439 06	$32,943 43
Fixed charges	23,142 06	20,851 90
Surplus	$12,297 00	$12,091 53

OAKLAND, CAL.—The February statement of the Oakland Traction Company compares with February, 1908, as follows:

	1909.	1908.
Gross earnings	$205,100 51	$210,591 13
Operating expenses	102,258 16	110,303 22
Net earnings	$102,842 35	$100,287 91
Fixed charges	45,367 32	45,830 74
Surplus	$ 57,475 03	$ 54,457 17

The decrease in gross earnings in February was $5,400, compared with a decrease of $10,500 in January. The surplus increased $3,000, as compared with a small decrease in January.

FINANCE.

BAKERSFIELD, CAL.—The Springfield Oil Company has levied an assessment of 2 cents per share on the capital stock of the company.

BAKERSFIELD, CAL.—The Loveland Oil Company has levied an assessment of 7 cents per share on the capital stock of the company.

VISALIA, CAL.—The Wutchumne Water Company has levied assessment No. 130 of $10 per share on the capital stock of the company.

SAN FRANCISCO, CAL.—The Union Oil Company has levied assessment No. 1 of 10 cents per share on the capital stock of the company.

BAKERSFIELD, CAL.—The Bakersfield Fuel & Oil Company has levied an assessment of $100 per share on the capital stock of the company.

TACOMA, WASH.—Bids will be received April 5 for $300,000 electric light and power system bonds—John F. Meads, Comptroller; Ray Freeland, Treasurer; J. W. Linck, Mayor.

SAN LUIS OBISPO, CAL.—An election for the issuance of bonds amounting to $180,000 for municipal improvements has been called. The city contemplates expending $80,000 for improving the water system; $60,000 for extending the sewer system, and $10,000 for other improvements.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer — who will listen with a willing and eager ear to the story of quality.
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INDEX TO ADVERTISEMENTS

BATTERIES

DRY BATTERIES

Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Standard Electrical Works, "Standard."
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Western Electric Co., "Blue Bell," "Liberty."

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Western Electric Co.

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Elec. Storage Battery Co.
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Electric Appliance Co., "Ansonia."
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Electric Goods Mfg. Co.
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Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

BOILERS

Henshaw-Bulkley & Co.
Keystone Boiler Wks., "Parker."
Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, Edge Moor."

BOOKS

Technical Book Shop.

BOXES

WALL BOXES

Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knockout."
Chicago Fuse Wire & Mfg. Co., "Union."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
General Electric Co.
Paiste, H. T. Co.
Pass & Seymour.
Sprague Electric Co., "Universal."
Standard Elect'l Wks., "M & M."
Stanley & Patterson, Inc., "Simplex."

BRACKETS

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The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional [illegible] cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity Power and Gas *604 Mission Street, San Francisco.*

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.

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MR. MANUFACTURER: I am young, alive, advertising manager, large electrical manufacturing company, Chicago. Fifth year. What I am accomplishing is my proof that I can do better. Will you give me a chance? Address, Opportunity, care **Journal of Electricity,** Box 105.

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FIBRE CLEATS
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General Electric Co.
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Westghse Elec. & Mfg. Co.

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Standard Electrical Works "Jandus."
Western Electric Co., "Hawthorne."
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Westghse Elec. & Mfg. Co.

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Electric Appliance Co., "Colonial."
General Electric Company
Sprague Electric Co., "Lundell."
Standard Elec. Wks., "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

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Standard Elec. Wks., "M. Co."
Western Elec. Co., "W. E.
Westghse Elec. & Mfg. Co.

NOTICE

How to Use Pipe-Ends

The entire Pipe-Ends system is based on just two hard drawn steel boxes, one rectangular (No. 1201 in the 1½ inch size) and one octagonal (No. 1203 in the ½ inch size.)

The RECTANGULAR BOX has seven openings altogether—three knock-outs on one side, one in the other side one in the bottom, and one in each end.

On a given job it is only necessary to determine how many of these you want of each pipe size. As you come to the first place where a box is required, hit the knock-out sharply in the middle and drive it in where you want to put the pipe (end, bottom or either side).

To make TYPE "E" (Fig. 6). Strike the knock-out in the end (No. 1201, Fig. 5) a sharp blow with a round-nosed hammer and put a nipple (No. 1240, Fig. 1) into the opening from the inside. It has a square head and won't turn round in the box, so you can screw this threaded nipple and box right into the pipe coupling and you have got a straight, neat job, that won't crack or ever give way. Cut (Fig. 6) shows a porcelain cover with pipe drop which, of course, you can put on afterwards, or any cover you want.

To make TYPE "A" (Fig. 7) for Greenfield or Sprague duct drive in the bottom knock-out, put in square nut No. 1245 (Fig. 4) and screw from the outside through the box and into this square nut No. 1242 (Fig. 2).

This fitting is tapped on both sides so that the set screw can always be put in from the outside when the box is against the wall.

If you want a TYPE "X," Fig. 8 shows how to do it. Cover in this cut is a Marshall 1, 2, 3 wire cover. You can make smooth holes in this cover to suit yourself, too. Simply push out the cement with a screw-driver, where you want a hole.

To make ½ inch size, TYPE "G" (Fig. 11), which will fit ANY Switch you can find of 5 or 10 Amp. capacity, ANY Receptacle, or ANY Rosette, take Box No. 1203 (Fig. 9) and Universal Cover No. 1232 (shown in Fig. 10). Adjust the tapped holes "A" and "B" by pushing BOTH hinged clips at once with the fingers, in or out, so that it will just fit the fastening holes through the porcelain; then loosen up the two screws in this cover, set it on the box (No. 1203, Fig. 9) so that the clips will extend under the turned over rim, turn it round in any position you want to bring the Switch or Rosette right; tighten up these screws, BEING SURE THAT THE CLIPS ARE TURNED UNDER THE RIM. Next, thread your wires through the Switch, Rosette or Receptacle, fasten it to the box with the machine screws sent with the cover. It will fit any SWITCH, ROSETTE or RECEPTACLE.

The square nut (Fig. 4) is used to join two boxes together end on end and in connection with the male and female bushing (No. 1851 in the ½ inch size) for threading the end of the pipe directly into said bushing without the use of a coupling which is used on end of all pipe for the No. 1240 bushing. Some users prefer this method of construction to using the No. 1240 style of connection. This can also be used for Sprague and Greenfield conduit making a construction approved by the Underwriters.

Over 200 different combinations can be made with these two boxes, and don't forget that you can make up anything you want as you go along on the job. No waiting and no dead stock. Sizes, ½, ¾, 1, 1¼.

We are pleased to answer questions, and will appreciate your suggestions.

DUNHAM, CARRIGAN & HAYDEN CO.

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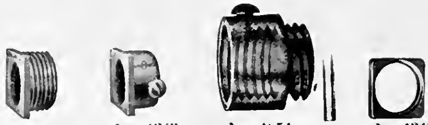
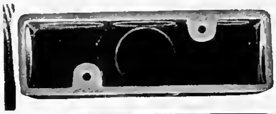


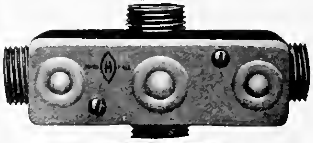
No. 1240 (Fig. 1) No. 1242 (Fig. 2) No. 1851 (Fig. 3) No. 1245 (Fig. 4)



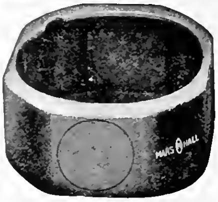
No. 1201 (Fig. 5)

TYPE "E" (Fig. 6)

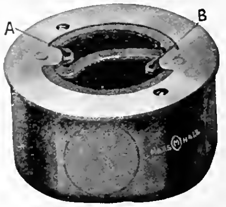
TYPE "A" (Fig. 7)



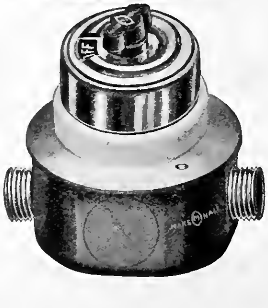
TYPE "X" (Fig. 8)



No. 1203 (Fig. 9)



No. 1203 and No. 1232 (Fig. 10)



TYPE "G" (Fig. 11)

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Western Elec. Co, "Fletcher"

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Roeblings Sons Co., John A., "Knowles."
Standard Electrical Works, "Standard."
Western Elec. Co., "Brookfield."

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Pass & Seymour.
Pierson, Roeding & Company, "Locke."
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Thomas & Sons Co., R.
Western Elec. Co., "Thomas"

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Standard Electrical Works, "Standard."
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Western Elec. Co., "Thomas"

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Paraffine Paint Co., Agents "P. & B." Products.
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Columbia Inc. Lamp Co. "Columbia."
General Elec. Co., "Meridian Tantalum."
Kieruiff, B. F. Jr. & Co. "Excelsior."
Sunbeam Inc. Lamp Co "Sunbeam."
Western Electric Co., "Sunbeam."

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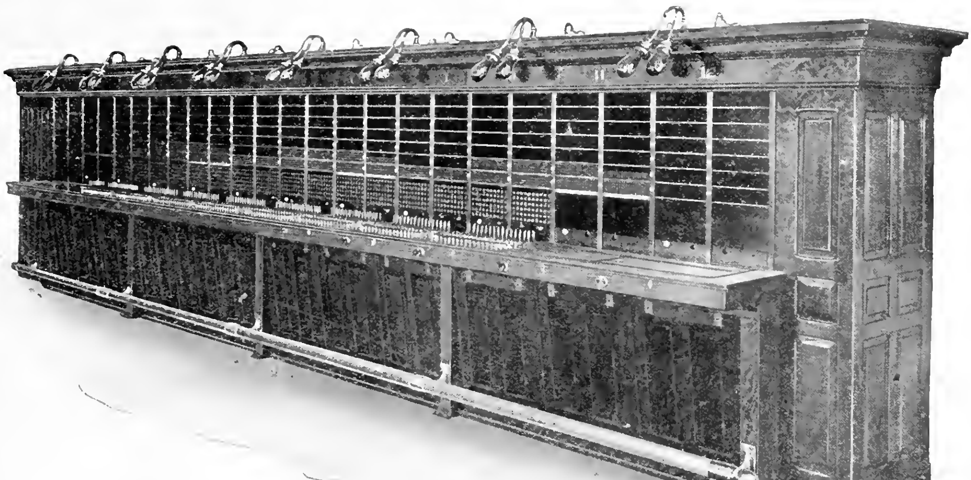
TELEPHONE SWITCHBOARD AT EVERETT, WASHINGTON.

BY GEORGE A. SCOVILLE.

The growth of independent telephony in the Northwest has always been assured through the wisdom of many large operating companies. As compared with cities of small size in the East, most of the purchasers have bought equipment of a remarkable ultimate capacity. Everett, Wash., for instance, is a city of about 25,000 inhabitants. The old Eastern telephone operator, in a city of this size, would purchase no larger than a three-section common battery board, which would be amply sufficient to meet his most sanguine expectations. If such a scheme had been adopted in Everett, the remarkable success and growth of the Farmers' Mutual Independent Telephone Company would have necessitated the early purchase of exchange additions that could not have been installed as reasonably as with the initial job.



Telephone Switchboard at Everett, Washington.

In December, 1906, a four-section Dean common-battery multiple switchboard was installed. Complete power and terminal facilities were also provided, as well as ample switching room for toll-calls, and modern wire chief's and chief operator's desks. In fact, the exchange was the most modern obtainable at that time, and the operating company has kept the equipment thoroughly up to date. Provision was made for handling 960 local lines. Since their equipment is designed for operation by means of the Dean harmonic system, this number does not represent the total number of subscribers that might be handled without increasing the exchange facilities. The harmonic party line ringing system has since been developed so that many operators are able to average three subscribers to a circuit. Any telephone investor will appreciate

how profitable would be any development that would not require a proportionate increase in the exchange investment.

The switchboard proper consists of four sections of six panels each. Each section provides three operators' positions, and the ultimate capacity of the entire board is 3,000 lines. The trunking facilities from the toll board and from the wire chief's and chief operator's desk are looked out for in the second position. From the third to tenth positions, inclusive, each operator handles 120 incoming lines, with ten per strip answering and lamp jacks. Each position is provided with 15 local cord circuits, all of which are equipped with Dean harmonic four-party ringing keys, which are operated without the use of ground or third-wire connections. Breast-plate transmitters are used throughout.

As will be noted from the illustration, the eleventh and twelfth positions were left blank in the original installation. These have been partially filled up by rapid increase in business since the board was cut over. The illustration will further show the method of lighting, which has been very satisfactory. Connections are provided on the rear of the board for power for the lights for the switchboard man and for his soldering iron, etc.

The chief operator's desk provides a monitor's position, which contains a most improved system of supervision. This consists of line supervisory pilot lamps for each operator's position, so arranged that the monitor is informed instantly of the failure of any operator to do her work promptly. This monitor is provided with means of listening on a conversation without the operator's knowledge.

The wire chief's desk provides just as efficient equipment for performing his work. He is able by simply throwing the key to determine the actual technical condition of any line. He has several testing trunks to the main operating board, and it should be noted that when he makes a test on a line or when the monitor listens in on a line that this in no way interferes with any incoming or outgoing calls on that circuit. This wire chief's desk is equipped with the most modern technical testing equipment.

The toll board consists of one section of two positions. Since the original installation it has been found necessary to continually make additions to this department of the exchange. The Everett power plant is one of the most complete telephone installations on the Coast. All power may be generated in the building by a gas engine outfit. Complete storage batteries were installed along with the original equipment, and Dean harmonic converters provide selective party line ringing frequencies in a most satisfactory manner.

Tungsten lamps in Germany are being marketed in 16-candle-power size and can be used in any position. There has been a recent reduction of about 30 per cent in German tungsten lamps, the 16-candle-power lamps for 100 to 130 volt service being listed at 50 cents.

A telegraph line across the Sahara desert is being built to connect Algeria with French colonies to the south near Timbuctoo. Hollow steel poles are being used.

STORAGE BATTERIES IN TELEPHONE SERVICE.[1]

BY GEORGE. R MURPHY.

The use of the storage battery has now reached such proportions that one might truly say that it is used in every branch of the electrical art, and the growth of its manufacture has been exceedingly rapid. In telephony alone, the increase in the number and size of cells installed has been very great, especially in the past ten years. It might be said that the storage battery has made the common battery system possible, and in addition has proven on innumerable occasions, an able and ready friend during times of emergency and trouble. In no field is the watchword, "continuity of service" so vital and important as in telephony, and yet in this service the manufacturer is frequently surprised at the conditions under which the battery is installed and the subsequent care it receives. A machine with moving parts, either rotary or reciprocating, will indicate almost immediately any trouble caused by lack of attention, but the storage battery will stand for a considerable length of time any abuse or rough handling. It does not give out suddenly, but continues to perform its work long after it should have received attention, and when the point of failure is reached, it may be seriously damaged.

For this reason, it is most advisable and more economical to give the battery from the very beginning, the attention and care it should receive. The amount of labor and material required is small, and offsets many times over the expense of too frequent renewals of plates. This view of the situation is frequently given small consideration by the operating companies, and in this article I will endeavor to show some methods of the care and operation of a battery in telephone service.

INITIAL CHARGE.

Assuming that the battery has been installed and the eletrolyte added to the cells, the first step in putting the battery into commission is the "initial" or first charge. It is extremely important that this charge be properly given and carried to completion. The positive pole of the generator, or charging source, must be connected to the positive terminal of the battery, as charging in the wrong or reverse direction will always result in serious and permanent injury to the plates. The polarity of the charging source can best be determined by a voltmeter, and the positive and negative plates of the battery are readily recognized by their color, the former being brown, and the latter a light gray.

The length of time taken in the initial charge cannot be exactly stated, but approximately speaking it consumes from forty-five to fifty-five hours at the normal rate or its equivalent in ampere hours, i. e., if the charging rate was reduced fifty per cent, it would take twice as long as if the normal rate was used, but the number of ampere hours would be the same in each case. Charging should begin at the normal rate immediately after the electrolyte has been added to the cells, and should preferably be continuous, until there is no further increase either in the specific gra-

[1] Abstract of paper read at Southern California Independent Telephone Convention, January 23, 1909, Pomona, Cal.

vity of the electrolyte and the voltage over a period of ten hours, and all the plates are gassing quite freely. These readings should be the only guide to the determination of the end of the initial charge, and whereas the approximate time in hours has been mentioned, even the maximum limit given may be increased if there are any interruptions to the charge or the plates have been standing in electrolyte for any length of time before charging commenced.

It is advisable in all cases to follow this first charge closely by taking readings of the gravity, voltage and temperature of the electrolyte of one or two pilot cells at least once every hour, and it is well to forward a copy of these readings to the nearest office of the manufacturer, for confirmation that the charge has been thorough and properly conducted.

In addition to the readings on one or two pilot cells, all the remaining cells should be carefully watched in order to ascertain that they are gassing. If any are not, these cells should be examined at once and the cause of the trouble removed. The temperature of the electrolyte should also be watched and at no time should it be allowed to exceed 100 degrees Fahrenheit. If there is any tendency to closely approach this figure, it is advisable to either decrease the charging rate, or if this does not have any effect, to stop the charge entirely and allow the cells to cool.

As soon as the operator has satisfied himself that the charge has been completed according to the conditions mentioned, a reading of all the individual cells should be taken. It will be noted that the voltage at the end of charge, with normal charging current flowing, will vary between 2.50 and 2.70 volts, and hence it is selfevident that a maximum figure and not necessarily a fixed value should be reached. The readings of the specific gravity will show that in the beginning the gravity dropped rapidly for several hours and then gradually rose to the proper value, 1210.

It might be mentioned here that with some types of cells, especially those containing what is known as the "pasted" type of negative, the electrolyte added to the cell before the beginning of the initial charge, has a gravity of 1170, while the standard "box" negative used in the larger cells, calls for 1210 electrolyte, but with both types, the gravity at completion of this charge should be 1210 at a normal temperature of 70 degrees Fahrenheit.

If any of the cells should happen to have a gravity lower than 1205 or higher than 1215 at this temperature, the electrolyte should be adjusted by adding acid in the one case, and pure water in the other. If all the conditions mentioned here have been fulfilled in every detail, the operator can safely assume that the battery is ready for regular service, and we can now proceed to the important points in connection with the subsequent care and operation.

CHARGING.

Proper charging is the most important part of the operation of a battery, and in the past much has been said and written about it, but even at the present time, especially in telephone service the evil of excessive and unnecessary charging exists.

Aside from the wasting of power, which is always an item of expense, especially as the majority of telephone companies purchase energy from outside sources, there also exists the more serious consideration of wasting away of the plates. The reason for this unnecessary and excessive charge has never been entirely apparent to the manufacturer. We can only conclude that either the operator is generously inclined toward the battery or excessive charge is considered the panacea for everything that occurs, or is likely to happen.

There are two general reasons for charging:

First, to put back the energy taken out on the previous discharge and be ready for another discharge.

Second, to keep the battery in good condition and obtain maximum life from the plates.

The first case illustrates what is known as the "regular charge," and the second, the "overcharge." The regular charge restores to the battery all the energy taken out on the previous discharge, while the "overcharge," given weekly or bi-weekly, as the case may be, evens up any irregularities that may exist in the different cells. The charging of a battery is a simple matter, but the vital point is the proper time at which to terminate it. The end of charge is detected in three ways: First, the increase in voltage; second, increase in specific gravity; and third, the amount of gassing.

Voltage Method—During charge, the cell pressure gradually increases, until, when the battery is fully charged, there is no further rise, irrespective of the length of time that the charge is continued. The point at which there is no further increase in voltage is known as the "maximum voltage." At one time, there existed a general idea that it was necessary to charge to a fixed voltage, but, happily, this incorrect method is gradually passing away, and it must be understood that the "maximum voltage" is not fixed in any way, but on the contrary, the actual value will vary, depending on the age of the battery, the temperature, the specific gravity of the electrolyte and the charging rate.

The disadvantage of using the voltage method only, lies in the fact that any variation in charging current will necessarily cause a change in cell pressure, and furthermore, it is very difficult to make temperature corrections, the voltage at times of high temperature being much lower than normal, while the reverse is true of low temperature.

Specific Gravity Method—During the discharge of a cell, there is combination between the acid in the electrolyte and the active material of the plates, the latter becoming somewhat sulphated. There is also a gradual reduction in the specific gravity of the electrolyte, and during the charge, the reverse happens, the acid leaves the plates and the specific gravity of the electrolyte increases. This rise and fall of gravity, due to charge and discharge, is directly proportional to the ampere hour input or output, and any variation in rate of charging or discharging current has no bearing whatever.

It is necessary in using this method, however, to make some corrections, that is, for temperature and evaporation. The temperature correction consists in adding or subtracting one point for a variation of every three degrees (Fahrenheit), above or below normal temperature or 70 degrees Fahrenheit. If

the specific gravity at 70 degrees Fahrenheit is 1205, at 55 degrees Fahrenheit, it would be 1210, and conversely at 85 degrees Fahrenheit, it would be 1200. Variation due to the evaporation can also be corrected by adding each day the necessary amount of pure water to keep the electrolyte at a predetermined level, preferably 3/4 of an inch above the top of the plates. There might also be the objection that a hydrometer is not as easy to read as a voltmeter, but the newer type of instrument has an increased range, and there is less chance of error than heretofore.

As the variable features of the gravity method are so easily corrected, the reasons for preferring it to the voltage method are self evident, but it must be understood that both should be considered, as one serves as an excellent check on the other.

Gassing—As a battery is charged, there is some gas given off, little or none in the beginning, gradually increasing, while toward the end, the gassing is more or less violent. While this gassing may, at times, help as a guide, it is impossible to depend on it for any accuracy, and it is only used where local conditions prevent the adoption of either of the first two methods.

Color of Plates--The color of the plates may serve as a partial guide to experienced battery men, but this is only a check on the charging methods used, and not for any individual charge as the variation in color, from a state of charge to that of discharge is very slight.

Pilot Cell—When a battery has been installed and the initial charge completed, the first essential point is the selection of a cell as a guide to the operation, known as a "pilot cell." This "pilot cell" should be so chosen as to be of easy access, but should not be at the end of a row. It should also contain plates that are of the same age, and if the battery is made up of plates of different ages, a cell containing the older plates must be used. Readings on this cell should be taken frequently in order that the operator may know, at all times, the state of charge or discharge of the battery. The height of the electrolyte in this cell must be kept at a constant level, either by hand or automatically, by adding a little water from time to time. Water added in this way should be put in at least once a day to avoid a sudden fall in gravity.

It is always well to mark this level of the electrolyte, either by painting a line on the outside of the glass jar, or if the cell in question is installed in tanks, an "S" shaped piece of lead, hanging from the glass supporting plates will answer the purpose. When cells are not equipped with the full number of plates, naturally the variation in gravity over a cycle of charge and discharge is necessarily reduced, because of the excess electrolyte. In order to avoid any chance of error because of this decreased variation, it is advisable to displace the excess electrolyte by using a specially constructed lead tank, or if the plates are assembled in glass jars, a wooden block, weighted and properly treated, may be used. Once a pilot cell has been selected, it should not be charged unless for special treatment or repairs.

Readings might be taken on all the cells to check up the operation, but we have found by experience that it is not necessary, and that one cell may be taken to represent the others. Readings of all cells would also entail coniderable labor on the part of the attendant.

General—In general, a battery should receive a "regular" charge when it is from one-half to two-thirds empty, and if it is necessary to give a regular charge daily, an "overcharge" should be made once a week, or bi-weekly if the regular charges are not given so often.

It is not usually advisable to charge until the specific gravity has dropped at least fifteen points below the maximum reached on the previous overcharge for a cell in which all the plates are installed or where a displacing tank is used in a cell partially filled with plates. If the displacing tank is not used in a partially equipped cell, this limit should be restricted to a ten point drop. If the voltage method only is used as a guide, it is almost impossible to state when a charge should be started, as the cell pressure varies with the rate of discharge. Consequently, this characteristic of a storage battery cell demonstrates the superiority of the specific gravity method.

Regular Charge—This charge should, in all cases, where it is possible, be given at the normal rate. It lower rates are used, the charging consumes more time, and the increase in voltage is so small, it is more difficult to detect the cutting off point or completion of charge. Higher rates of charge need very careful watching in order to detect the proper point for cutting off the current, and if kept up after the cell is charged, they cause abnormal temperature rise in the cell, furthermore, the violent gassing tends to wash out the active material of the plates.

The charge at the normal rate should be continued until the gravity in the pilot cell has risen to within five points of the maximum obtained on the previous overcharge. If no displacing tank is used in a cell partially equipped with plates, the charge must be continued until the gravity is within three points of the maximum. The voltage will also rise until it is .05 to .10 volt per cell below that figure reached on the preceding overcharge, the charging rate being the same and constant in both cases. Furthermore, all the cells should be gassing moderately, but not so violently or freely.

Overcharge—When it is found necessary to charge a battery daily, the overcharge should be given once a week and preferably on the same day of each week. If the battery is charged less frequently, the overcharge should be given bi-weekly. In both cases, the charge should be continued until both the gravity and voltage reach a maximum value, and show no further increase for one or two hours and all cells are gassing freely. It should be carefully noted that these values are not necessarily the same at the end of each overcharge. No attempt should be made to reach a fixed value, but the charge should be continued until neither voltage nor gravity will rise any higher, irrespective of what figures are reached.

It will be noticed in these overcharges that the cell voltages will vary throughout the life of the plates, the values varying between 2.55 and 2.60 at normal temperature— 70 degrees Fahrenheit—when a cell is new, and as low as 2.40 when the age of the plates

has increased. The effect of temperature as stated before will also be very marked.

Although excessive charge is to be particularly avoided on account of the detrimental action on the plates, it might be well to state that these periodic overcharges, instead of causing any injury, are very beneficial and necessary. The necessity of continuing these overcharges, for an hour or two, will be readily recognized from the fact that unless the charges are so carried through, it would be difficult to obtain the true maximum value. Furthermore, the long overcharge is necessary in bringing up any cells that may have dropped behind and become temporarily less efficient than the others. Naturally, if the interval between overcharges is lengthened, the greater the variation there may be between the different cells, and it is advisable in all cases to make it a practice to overcharge periodically weekly or bi-weekly, according to the work the battery is called upon to perform. It is self evident then, that the overcharge sets a fixed standard for the subsequent operation of the battery and especially for the determination of the end of subsequent regular charges, but on account of many variable characteristics it is not well to use this fixed standard more than two weeks and hence, this is the longest time that any battery should run without an overcharge irrespective of the work it does.

DISCHARGING.

Just as there is an increasing voltage during the charge of a battery, conversely during discharge, there is a decrease. This decrease is very slight during the greater part of discharge and very gradual, but it is very marked toward the end. The limit is reached, if the battery is discharging at the normal rate, when the voltage has fallen to 1.75 volts per cell.

With rates other than normal, however, the limiting voltage varies, as does the drop in gravity and capacity in ampere hours. At rates higher than normal, the voltage at the end of a complete discharge is lower and the fall in gravity and the ampere hour capacity is also less. The fall in gravity is an excellent indication of the amount taken out during discharge, and this is especially true when the rate of discharge current varies over a considerable range.

With a cell fully equipped with plates, the drop in gravity is about 35 points for the full eight hour or normal capacity, and as the fall in gravity is independent of the rate of discharge, and directly proportional to the number of ampere hours taken out, the state of discharge of the battery can be readily calculated at any time, providing the maximum at the end of the previous overcharge is known.

If there are less than the full number of plates in a cell, there will be an excess of electrolyte, and consequently the drop in gravity will be less. In order to get as wide a range as possible, and thereby increase the accuracy of readings, the displacing tank should be used.

For determining the limits of discharge at any given rate, the voltage and gravity should both be taken into consideration, for, whereas the gravity drop, especially in the form of the gravity limit curve shown, Fig. 1, is a very ready method of showing the discharge limit as well as the percentage of capacity taken out, it does not necessarily show the actual capacity, and the voltage should be ued as a protection in case the capacity of the battery in question is below its rating. In general, a cell should not be discharged below its ampere hour capacity, neither should it be discharged at rates higher than it was intended to work.

Floating—"Floating" has been very common in lighting work, partly for regulation, and also to act as a ready reserve in case of any interruption of the prime movers or other points of the system, to automatically take care of the load. The term "floating" is generally applied to that method of operation where the battery is connected to the generator bus, but the voltage of the generator is so adjusted that the battery will not take care of any continued charge or discharge, although it may take care of any rapid fluctuations and thereby keep a steady load on the generator. Floating has been used in telephone service more or less recently, but its use is frequent, especially in such exchanges where only one battery is installed with a generator.

It is readily recognized that the best practice is to charge during times of the heaviest exchange load, as the generator is then working at its best efficiency. If

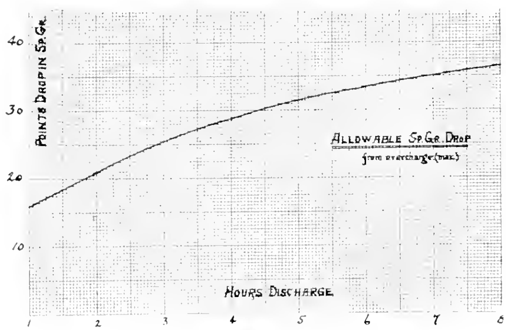


Fig. 1.

the battery has been charged, and if the load on the exchange still warrants the running of the generator, the current on the machine is reduced so that it is just equal to the exchange load, and the battery is connected to the bus ready for any emergency. It also acts as a regulator, preventing any cross talk. The battery is generally floated in this way until such time as the exchange load drops off to a point where it is uneconomical to operate the generator. Care should be taken to float the battery in such a manner that the battery will receive only sufficient charge to compensate for the discharge, as floating at too high a point causes excessive charge, while floating at too low a point results in discharge.

Th result of investigation on a large number of plants has demonstrated that if the voltage is maintained at an average of 2.08 volts per cell, the battery will be kept at the proper point. It should be especially noted, however, that the battery should not be floated when the gravity is at its maximum density, for example, at the end of an overcharge, as at that time the fluctuating charges will cause gassing and excessive

charge. It is far preferable to float at a point equivalent to the end of the "regular" charge. There are several methods used for watching the correct floating point.

(a) A very simple device is a recording voltmeter, with the proper range, connected directly across the battery terminals. This meter is generally designed for a 24-hour record and can be placed directly at the switchboard. If connected across 11 cells, the proper average for floating should be 23 volts, and with 22 cells, the corrected figure is 46 volts. The curve on the dial shows at once whether the floating has been too high or too low.

(b) Where it is possible to do so, periodic readings of the pilot cell gravity during the floating period act as a ready tell-tale. If the battery has been floated properly, there will be no change in gravity over the floating period, whereas a rise or fall will denote that the voltage of the generator has been too high or too low for the battery during this time and should therefore be adjusted.

(c) Frequent readings of the battery ammeter would also serve as a guide, but this demands the constant attention of the operator, when his time and labor are necessary in other directions. There have been several meters of the integrating ampere-hour type designed and put on the market that deserve special attention. Two meters, one manufactured by the General Electric Company and the other by the Sangamo Electric Company are very similar in construction and have been found very reliable. The instrument manufactured by the General Electric Company is of the mercury motor type and is an improvement on the old Halsey ampere hour meter. This instrument is equipped with a register having a sweep hand which may be set back to zero whenever desired. Usually the meter is set at zero at the end of charge, and kept there by adjusting the bus pressure. It is so constructed that if the current reverses, that is, from charge to discharge, the rotation of the meter will be in the reverse direction and at the same rated speed per ampere in either direction. From the portion of the pointer it can be readily noted whether the charge exceeds the discharge or vice versa.

Briefly, the principle of operation is based upon the fact that electric current passed through the disc or cylinder immersed in mercury, where it is cut by a field from a permanent or electro magnet, will cause the disc to rotate in a direction at right angles to the flow of the current, the torque being proportionate to the intensity of current flow, assuming the field constant.

AUXILIARY APPARATUS.

On account of the ea. e in operating by the gravity method, especially by the use of a pilot cell, some special apparatus has been developed. As stated previously, specific gravity readings are only correct indications of the state of charge or discharge when the temperature and height of the electrolyte remain constant. Any change in temperature must be compensated for, so also any variation in the height of electrolyte. This may be done by calculation, but this is a laborious proceeding and consequently apparatus has been designed to accomplish the same purpose automatically.

Compensating Hydrometer — This instrument is similar in general appearance to the hydrometer in use for many years. It has in addition, however, a small inner bulb, connected by a small tube to the electrolyte of the cell. When the hydrometer is properly adjusted, the small bent inner tube is filled with electrolyte up to the bulb, which is filled with air. Any change in temperature of the electrolyte will cause a corresponding variation of the volume of air in the bulb, and expel from the hydrometer or draw into it a certain quantity of electrolyte. This will vary the weight of the hydrometer, and this variation compensates for the change in specific gravity of the electrolyte due to temperature changes. To properly adjust this instrument, a reading of the gravity of the pilot cell after charge should be taken and the temperature of the electrolyte noted. The gravity reading should then be corrected to a standard temperature of 70 degrees Fahrenheit.

When the correct reading has been calculated, insert the compensating hydrometer in the electrolyte of the same cell, then remove it, and, by inverting it, allow the acid in the small tube to enter the bulb. This operation should be repeated until the compensating instrument reads the same as the corrected reading of the standard hydrometer.

A comparison of the standard and compensating instruments should be made on the following day to see if the adjustment is fixed, and if it is not, a further adjustment is necessary. For the first month it is desirable to check the compensating instrument weekly with readings of the standard corrected for temperature, but after that the comparison is not necessary so frequently. Naturally, it requires some time for an instrument of this character to adjust itself to the temperature of the electrolyte, so if it is moved about from cell to cell, at least fifteen minutes must elapse before any reading is taken. As a general rule, it is preferable to keep it in the pilot cell and take individual cell readings weekly or bi-weekly, as the case may be, with the standard hydrometer.

Automatic Cell-Filling Device—Constant evaporation from the surface of a cell will vary the amount of electrolyte, and naturally the specific gravity readings are affected. In some cells the amount of evaporation is as high as 3 per cent per week, and this will change the electrolyte approximately 8 points without any charge or discharge having taken place, producing an error of anywhere between 20 and 40 per cent, depending on the type of cell. This error may be corrected if the attendant adds sufficient water to the electrolyte daily to keep the height constant, but quite an error can be introduced if this proceeding is omitted for several days.

The automatic cell-filling device was developed by the Electric Storage Battery Company to insure a constant level of the electrolyte. Its operation is similar to that of the automatic float-valve, and, being constructed entirely of glass, with the exception of the rubber stoppers, is not acted on in any way by the acid fumes.

Signalling Hydrometer—Although the specific gravity method, as an indication of the state of charge or discharge, has been found to be the most preferable, it is, nevertheless, in some cases, impossible or troublesome for the attendant to take a number of readings

to determine accurately whether the gravity has reached a certain predetermined point, either on charge or discharge. Furthermore, it is necessary to make the temperature correction in each case demanding additional attention and time on the part of the operator.

The signalling hydrometer corrects automatically for temperature and gives notice at the switchboard, either by the ringing of a bell or the lighting of a signal lamp, that the gravity has reached the point that

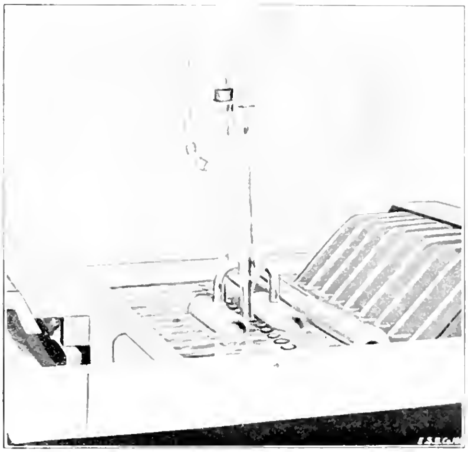


Fig. 2. Automatic Cell Filling Device.

the instrument is set for. The principle involved in the operation of this instrument consists in measuring by means of a balance the varying resultant weight of a bulb of constant volume immersed in the electrolyte. This bulb is filled with electrolyte, and as the temperature of the electrolyte of the cell changes, expansion or contraction of that in the bulb results and either some electrolyte is ejected or drawn into the bulb in such

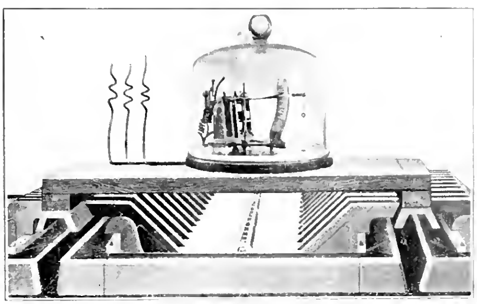


Fig. 3. Signalling Hydrometer.

amount as to cause the weight to vary inversely with the temperature.

Recording-Signalling Hydrometer—A further development of the signalling hydrometer is the recording-signalling hydrometer. The principle is precisely the same, with the additional feature that a permanent record is made of the battery operation and the personal equation of the attendant is checked at once. The moving mechanism or drum carrying the record is actuated by an eight-day clock so that a complete record of one week is obtained on each sheet.

Individual Cell Readings—From all that has been said about the advantage of reading the pilot cell frequently, it must not be inferred that these are the only readings to be taken. The readings of the pilot cell only serve as a guide to the regulation of the amount of charge and discharge the battery as a whole should receive, and, therefore, periodic readings of

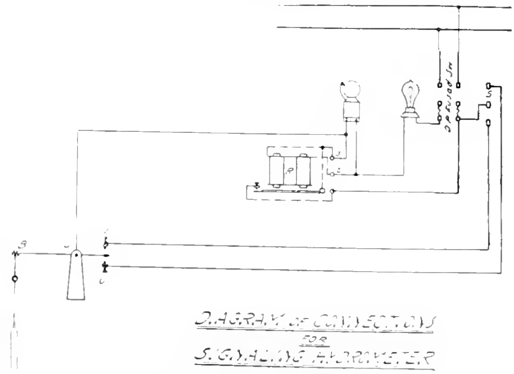


Fig. 4. Signalling Hydrometer.

voltage and gravity should be taken on the individual cells, the frequency of these readings depending on the number of overcharges the battery receives per month. In the first place, never take voltage readings on open circuit; they are of no value whatever. It is best to take the reading of the specific gravity of each cell on the day before the overcharge and at the same time in each case. An ordinary hydrometer will do for this purpose, as relative values only are desired. At the end of overcharge a voltage reading of each cell should be taken while the charging current is still flowing. If any falling off is noticed in any one cell relative to the others, this cell should be examined at once for

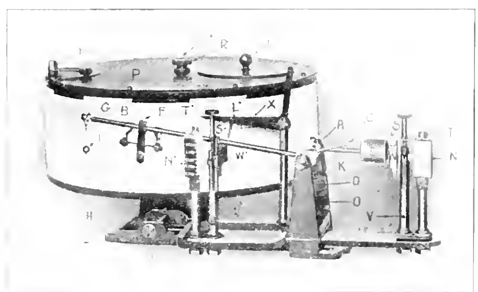


Fig. 5. Recording Signalling Hydrometer.

the possible cause of the trouble. These readings should be recorded on suitable forms and carefully kept on file.

Records—Too much cannot be said about records, as it is only by the careful keeping of them that a history of the work that the battery has performed throughout its life can be obtained. It sometimes happens that a battery is ready for renewals, and yet when

the question is being considered, there are no figures or facts to show that the equipment has performed the work for which it was installed, and quite often the blame is placed on the manufacturer when it does not belong there.

In general, the operation of any equipment or machinery that has a financial value should be carefully recorded, as in no other way can the maintenance be arrived at, and any figures are valueless unless they are founded on facts. In some cases it is the custom for the attendant to keep his records in a book, but I think that special forms so arranged as to contain the complete record of 1 week or longer are more advisable.

Inspection—Frequent inspection of the individual cells should be encouraged, but, of course, the frequency of inspection is dependent on local conditions. It is possible, however, in an 11-cell equipment to inspect all the cells thoroughly in approximately two hours. This time need not be spent continuously in the battery room, but may be scattered throughout the day. If the cells are of a small type, this time will be considerably lessened.

In general, it is well to get over all the cells at least two or three times a week, but I would advise that this work be performed even oftener, as frequent and close observations on the part of the attendant will do more towards his education than anything else. Aside from this feature, thorough inspection will always anticipate trouble, and this is certainly more satisfactory than the doubtful procedure of waiting for something to develop. Special attention should be given to the hanging lugs to see that they are not in contact with the adjoining lugs, and naturally any cells that read low at the time individual readings are taken should be carefully watched. The accumulation of sediment should be examined from time to time, and under no circumstances should it be allowed to touch the plates. This sediment can be easily removed from a battery made up of cells installed in glass jars by removing the elements, pouring off the clear electrolyte, washing out the sediment and replacing the element. This procedure, however, should only be performed when the battery is fully charged, and particular care should be taken not to allow the plates to become dry.

In the larger type of cells a special wooden scoop may be used to advantage and the sediment removed without disturbing the operation of the battery.

Another method of cleaning large cells is to draw off the electrolyte and thoroughly flush the cell with water so that the sediment will be stirred up. A syphon, preferably a 2-inch rubber hose, should then be inserted in the bottom of the tank so that the discharge will be as rapid as the inflow of water until the cell is free from sediment. The water in the cell should then be replaced by electrolyte.

Low Cells—The presence of low cells is readily detected by (1) falling off in specific gravity or voltage, relative to surrounding cells, (2) lack of gassing at the end of overcharge, and (3) by the color of the plates. The cause of the trouble should be sought out and removed at once.

Treatment—If the trouble is discovered immediately, it will be possible to restore the cell to the proper condition by the following overcharge. If this overcharge does not entirely restore it, the second overcharge may, or it might be necessary to charge the cell separately.

The simplest method is to overcharge the entire battery, but care must be exercised not to do this to excess. It is preferable to cut the cell out for several discharges and put it back in circuit again before beginning each charge. In this way the low cell receives the benefit of several charges without going through any discharge. Another method is to charge the cell from some outside source, either using the charging generator with a water rheostat in circuit or by cutting down the field excitation, or a special low-voltage machine may be used.

BATTERY ROOM AND VENTILATION.

An exceedingly important item is the design of the battery room and the proper means for obtaining ventilation. The normal temperature for a battery is 70 degrees Fahrenheit, so the aim should be to so design the room that the temperature can be kept between 50 and 80 degrees Fahrenheit. If the temperature is too high excessive wear on the plates will be the result, and whereas a cold room causes no harm, still the capacity of the battery is temporarily reduced while operating at low temperatures.

Ample ventilation should also be provided to insure a sufficient circulation of the air so that all stands, insulators, cells, etc., may be kept reasonably dry. At the end of charge a slight percentage of the acid is given off when the cells are gassing, and as acid is hydroscopic and will collect moisture from the atmosphere, keeping all surfaces where it settles damp, ample means must be provided for carrying off the gas and particles of acid. The deposit of acid on the insulators should be carefully watched, as this will start electric leakage, which will eventually cause electrolysis on the lead lining of the tanks, if they happen to be used, and the tanks will leak. Naturally, when the wooden shell of the tank is saturated with acid, deterioration is more rapid. It is not sufficient to wash off with water in order to obtain dryness, but, in addition, all parts, namely tanks, woodwork, insulators, floor, etc., should be washed occasionally with a solution of bi-carbonate of soda until all the acid is neutralized, and then remove with a stream of water all traces of the soda. Furthermore, if the gases given off on charge are closely confined, there is danger of an explosive mixture, and for this reason a naked flame should never be brought into the battery room when gassing is going on. The simplest method of ventilating is to make suitable outlets in the ceiling with a number of inlets near the floor level, about twice the area of the outlets. In some cases where the outlets and inlets cannot be properly arranged, forced draught is necessary.

Canadian telegraph lines, according to a report presented to the Dominion Parliament at Ottawa, recently, are not profitable. The receipts are $122,432.53, while the expenses amount to $386,567.34. In Yukon and northern British Columbia considerable difficulty is experienced through snow slides, rock slides, blizzards, etc., and a proposition is under consideration to install wireless systems where wire trouble is most prevalent.

LAW OF THE TELEPHONE.

BY EMERSON W. READ.

Reference has heretofore been made in these articles to the interference of trees with the stringing of wires by enterprises making use of wires in the regular course of business. From cases actually occurring and reported in the various courts of appeal it appears that such interference can be treated in three classes, namely:

1. When trees wholly stand on private property.
2. When trees root and stand on private property, but overhang adjoining property or highways.
3. When trees wholly stand on highways.

In the first class courts have no trouble in determining rights questioned on the interference with trees by employees of a company stringing its wires through the foliage. Too often has it been held that, should a telephone company cut away or trim trees wholly within the boundaries of private property, such company is liable for the damage done to the owner of the tree. In such instances the company should enter into an agreement with the owner relative to stringing wires through the tree, or else, actually avoid it. A reliable decision on this point is rendered in Tissot v. Great Southern Tel & Tel. Co. (2 Am. Elec. Cas. 286). There the company's servants cut away foliage in a valuable magnolia tree to the extent of about a thirty-foot circumference. It was shown that the company's servants had committed trespass, both in entering the premises and in cutting the tree. This follows directly as a consequence of the rules of law applicable to all private property, and especially the one insuring to an owner protection in the enjoyment of his property.

Some difficult questions arise in dealing with trees that protrude into the highway. On first impression it would seem that a company, owning a franchise to string telephone wires in a highway could, without further negotiation, trim trees that actually and unavoidably interfered with the company's operations. This was the fact in Southwestern Tel. & Tel. Co. vs. Branham, a Texas case (74 S. W. 949). There it was determined that trees so protruding cannot be trimmed and chopped away summarily. First the municipal government must declare such branches to be public nuisances and abate them as such. In the absence of any finding by the proper authorities that such constituted a nuisance, they cannot be dealt with by the company as such.

Care must be taken in trimming trees back to the owner's line. Any unnecessary cutting or spoliation beyond the line, or even an intrusion upon the land of the owner, in carrying on the authorized work, will constitute a trespass. The case of Memphis Bell Tel. Co. vs. Hunt (1 S. W. 159) suggests that limbs of trees protruding from private grounds into the highway might be trimmed from ladders.

Another condition arises, too, with respect to trees of this class. Trees, in their spreading, might encompass wires long in place and hung at a time when no such trouble or source of annoyance existed. This was the Branham case doctrine. The company, under such conditions, cannot take summary action, however. True, it has a suit for damages, yet its relief must be had from the hands of the municipality, to-wit: have the city remove the obstruction.

From this it cannot be implied, however, that owners of trees are entitled to space above the highway at their pleasure. In that particular they owe a duty to travellers and the municipality to use reasonable care to prevent trees on his land becoming a menace or a danger to those using the highway as travellers on the street or as companies erecting poles, wires, car systems, and the like.

It may be said by way of modification that the rules above stated differ with the various state jurisdictions. For instance, Michigan has decided (Wyant vs. Central Tel. Co., 123 Mich. 51) that notice need not be given to either owner or municipality by a company stringing wires under a proper franchise if such limbs protrude over the owner's line and obstruct the hanging of the necessary wires.

Questions arising out of the third class shown above are subject to much legal difficulty in solution. Two elements are to be regarded in dealing with cases of that nature: One, does the abutting owner own to the center of the street, his fee being subject to the public's easement of thoroughfare? Two, does the municipality own the fee of the street absolutely?

Generally speaking, telephone companies cannot trim trees growing wholly on the highway if the abutting owner owns to the center of the street. This is the general rule, though it has so many modifications that it now represents an elementary rule much departed from in the course of the development of modern rules.

In cases in which the municipality owns the fee simple title to the street one rule predominates. The abutting owner may be ignored (Wyant case) and the company may do reasonable and necessary trimming subject solely to the regulations of the municipality.

On the whole, the rules regulating the trimming by companies which string wires are reasonable and proper. But harsh rules have been established in some states. New York and Connecticut in the East, and Ohio and Illinois in the north central part of the United States, have come to such determinations as this, "a telephone company is liable to the owners of the trees even where the trimming does not go beyond what is necessary in the reasonable prosecution of the work of construction." Generally the states merely require that reasonable and lawful trimming by the companies be done. Unnecessary cutting of branches constitutes a trespass either if the branches are cut back and across the line of the owner, or if too large a circumference of foliage is cut in proportion to the needs of the wires.

State constitutions provide that the state governments shall not interfere in matters of municipal government which are purely municipal matters. Such a matter is the ordinance of a city prohibiting the injury of trees and encouraging their growth. An ordinance enacted by the Supervisors of a city providing a penalty for the cutting, trimming and breaking of trees, their limbs and foliage, is a police regulation and can be enforced against companies and individuals indiscriminately. A case of that nature arose in New Jersey when the state of New Jersey attempted to show such an ordinance (enacted by Orange Township) to be without the police power and invalid (61 N. J. L. 202).

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CONTENTS

Room For All

When people played the organ with their fists, when they could multiply only with the multiplication table before them, when hands did what is now done by heads, time and labor were of little consequence. Now, however, anything that saves time or work is no longer a luxury but an absolute necessity.

The judicious use of the telephone is a great saver of time, and consequently it is fast becoming indispensable. Likewise its injudicious use, such as by the stenographer during the noon hour, is a waste of time, but this is extraneous. Man's gregarious instinct is cognate with that of self-preservation, and it is satisfied by the telephone, whether in the case of the housewife in the city flat or the rancher in his lonely cabin.

Although the increase in its use has been great, yet there remains a demand for its services which existing companies cannot supply. There is still so much to be done that it seems futile to engage in internecine quarrels. The public wants service and cares little by whom it is given, so long as it is good. There never was a time so favorable for telephone development, nor is its field so limited as to shut out competition.

Competition, in its better sense of emulation, gives better service. It may even become co-operation in extending service, rather than opposition in limiting it. "Live and let live" is a better doctrine than "dog eat dog."

The field for the telephone is a broad one and there is ample room for all. A quart flask filled with alcoholic vapor will receive another quart of gasoline vapor without increase in volume, just as a glass tumbler filled with shot can hold a large amount of water without spilling. This is much like the case of the vegetable man who sells five bushels of big potatoes and one bushel of small ones from his original five bushel basket. With so many fields as yet undeveloped, however, there should be no necessity to duplicate lines except where public opinion demands better service or a better rate.

At a recent meeting of independent telephone men in Boston it was the consensus of opinion that there is a greater demand for telephone service than existing organizations can supply and that the plan of the independents will be to offer good service at fair rates and let competition take care of itself. We have often spoken of the great strides being made by independent telephone companies on the Pacific Coast. The fact that sixteen and one-half million dollars are to be expended by the Bell companies in improving their service goes to show that this competition is felt. As long as it results in improvement of service the public is satisfied.

CURRENT COMMENT

Wireless communication from Paris to Canada, a distance of over 3,000 miles, is maintained by the stations on the Eiffel Tower and at Glace Bay.

Wireless for the Orient is to be established by the United Wireless Company. A chain of wireless stations will be established from Vladivostok to Aden, to communicate with the steamships in the Pacific.

Coyote hunting by telephone is reported from Gridley, California. After crippling the animal a farmer telephoned to his neighbor that it was headed his way. The second farmer missed the coyote but telephoned to a third farmer who killed the animal.

Electric smelting of iron ore is to be tried on a commercial scale in Norway. The first installation includes two 2,500 h. p. iron furnaces and two 600 h. p. steel furnaces. Two phase current is to be used and the system of Otto Stolhane of Sudrika, Sweden, installed.

A big bond issue of $16,500,000 first mortgage and collateral trust five-per-cent sinking fund thirty-year gold bonds of the Pacific Telephone and Telegraph Company is being offered for public subscription at 95.5 and accrued interest, simultaneously in New York, Chicago, Philadelphia and Boston. The bonds may be retired at 110 on January 2, 1922, or any interest date thereafter. The new bonds are secured by a first mortgage, either direct or by deposit of securities on the entire plant and property of the company, subject only to $3,000,000 bonds of one of the constituent companies maturing in 1913.

The wireless telegraph as a life saver was called into service in summoning aid for the Pacific Mail Steamship Indiana, which went ashore at Port Tosco on the western coast of Mexico this week. While the ship was pounding on the rocks the cruiser West Virginia, Admiral Swinburne's flagship, saw the distress signals which were sent up, and immediately summoned by wireless the cruiser Albany, with the tugs Fortune and Navajo, which were in Magdalena bay. The ships of lighter draft were able to go close to the wreck and take off the passengers and crew. The passengers were carried to San Francisco by the armored cruiser California. All news of the disaster until the arrival of the cruiser was by wireless telegraph.

An important telephone decision by the Indiana Supreme Court relates to the exchange of service through physical connection of rival lines. The court was asked by the complaining company to compel the defendant company to restore the connection which had been severed in order to enforce the payment of disputed tolls. The court held that a telephone company is a common carrier of messages, and when the owner of one system of telephones and exchanges has made physical connection between his and other lines and exchanges in the surrounding country under an agreement for interchange of service for an intermediate period, and each has developed his own telephone system with reference thereto, the courts will, upon a proper proceeding, restrain the owner of such telephone system from severing relations with a single one of the connecting lines and exchanges, or compel him to restore a severed connection. The court ruled, however, that the complainant should have paid under protest the amount claimed as due for tolls and then recovered the same; that this was his adequate remedy and for his failure to invoke this remedy he was not entitled to a writ of mandamus to compel restoration of connection. The court added that after actual physical connection has been made between the lines of two systems of telephones, the property of each is impressed with such a public interest that neither can disregard it.

Indiana telephone legislation provides that any telephone company organized in the State shall have power to acquire by lease or purchase the lines, exchanges, franchises, rights and other property, or any part thereof, of other telephone companies, or to dispose of by lease or sale its lines, exchanges, franchise rights and other property, or any part thereof, and also shall have the power to acquire and hold stock and bonds of other telephone companies. Until this recent amendment was made the law did not permit a company organized under the laws of Indiana to hold stock in any other company. On the other hand, the Central Union and other companies organized under the laws of other States have had such right and power. The amended law puts home companies on an equal footing with foreign companies and is expected to stimulate and strengthen the independent system in the State.

The telephone for train dispatching was explained in a paper read before the St. Louis Railway Club, on February 12th, by Mr. W. E. Harkness. The orders are issued verbally by the dispatcher to the operator or operators over a metallic circuit telephone line in place of being sent by telegraphy. By means of selective apparatus each station is called individually without signaling the other stations on the line. It has been found that the operators answer the selector bell more promptly than they do the sounder, due partially to the extra volume of sound given by the bell and also to the fact that it will ring until the call is answered. The accuracy of the telephonic transmission is clearly shown by the fact that the dispatching and reporting of trains on a large number of roads have been handled for a year or more by telephone without mistakes having occurred. Telephones are now used for train service over certain sections by the Lake Erie Alliance & Wheeling, the Pennsylvania, the New York Central & Hudson River, the Chicago, Burlington & Quincy, the Lake Shore & Michigan Southern, the Chicago & Northwestern, the Michigan Central, the Chicago, Milwaukee & St. Paul, the Northern Pacific, the Delaware, Lackawanna & Western, the Great Northern, the Chicago, Rock Island & Pacific, the Union Pacific, the Illinois Central, the Canadian Pacific, the Atchison, Topeka & Santa Fe, the Erie, the West Jersey & Seashore and the Virginia Railroads.

DEATH OF H. D. SCRIBNER.

Herbert Dudley Scribner, Pacific Coast manager of the Allis-Chalmers Company of Milwaukee, Wis., died at San Francisco on April 3, 1909, aged 44 years.

In the death of H. D. Scribner, the electrical interests of the Pacific Coast have lost a man who was not only a business associate but a friend and comrade—a man whose many years of hard work in the period of early development unquestionably entitled him to a place among the pioneers of the electrical industry in this section.

He came to the Pacific Coast from the State of Maine, twenty-one years ago, and at that time, although but 23 years of age, he already occupied a high position in the electrical business.

Shortly after his arrival here he built the first electrical road on the coast at Seattle, which marked the beginning of electrical development in that section of the country. For some time thereafter he was associated with Howard C. Holmes, constructor of the San Francisco Ferry Building and in connection with Mr. Holmes undertook some extensive operations. Electrical lines at Stockton and Tacoma

Herbert Dudley Scribner.

resulted from his efforts, and Vancouver, B. C., saw its first electrical railway constructed by him.

Among other engineering feats by which his name will be remembered is the line which connects Oakland and Haywards, Cal.

Following the above work he became associated with the San Francisco office of the Westinghouse Electric & Manufacturing Co., where he occupied an important position in the Power Apparatus Sales Department for many years. It was while he was with the Westinghouse Company that he received and accepted the offer of the Allis-Chalmers Company to take the management of their Pacific Coast business, which position he occupied at the time of his death.

Mr. Scribner's home was in Alameda, Cal., and he is survived by a wife and three children, two girls and a boy.

Services were held at his late home on April 6th, at which time his many friends and associates testified to the esteem in which he was held by numerous floral tributes; a large deputation of the San Francisco lodge of Elks, of which Mr. Scribner was a popular member, participated in the services.

PERSONAL.

F. H. Poss of San Francisco is at Victoria, B. C.

Thomas G. Grier, general sales manager of the Nungesser Electric Battery Company, has sailed for Porto Rico.

W. H. Whiteside, president of Allis-Chalmers Company, Milwaukee, Wis., arrived in San Francisco this week from Los Angeles.

A. M. Little has resigned as representative of Pass & Seymour to become general manager for the Mohawk Electric Company of Syracuse, N. Y.

E. H. Stevens has resigned as general superintendent of plants of the Public Service Corporation of New Jersey to become vice-president and general manager of the Bird-Archer Company, manufacturers of boiler compounds, 90 West street, New York.

NEWS OF THE STEAM ENGINEERS.

A large audience composed of members and friends of California No. 3, National Association of Stationary Engineers, attended an illustrated lecture on the "Parsons Turbine" at the association rooms Wednesday evening, March 31st. The subject was ably handled by Mr. Charles W. Baker, who prefaced his remarks by giving a short history of the turbine from the days of Hero, to the gradual evolution of the modern parallel and double flow turbine, illustrating his remarks by lantern slides.

The Educational Committee of the association announced that on Wednesday evening, April 7th, a talk on "Motors" will be given at the association rooms by Mr. J. Henry Klink of the Westinghouse Electric Company, which promises to be of much interest to the engineers and their friends. A general invitation to attend is extended by the association to anyone interested in the subject.

San Francisco No. 1, N. A. S. E., at its last meeting decided by unanimous vote to affiliate with the California State Assoicaiton, N. A. S. E. Steps to that end will be taken immediately, and delegates elected to attend the State convention in June coming.

TRADE CATALOGUES.

The General Electric Company has issued Bulletin No. 4654 devoted to the description of G. E. Section Switches.

Bulletin No. 4655, from the General Electric Company, gives a description of an electric furnace adapted to tempering and annealing.

An attractive booklet from the General Electric Company states the advantages of tantalum incandescent lamps for lighting railroad cars.

Westinghouse Multiple Tungsten lamps for alternating or direct current circuits are illustrated and described in Circular No. 1160 from the Westinghouse Electric and Manufacturing Company.

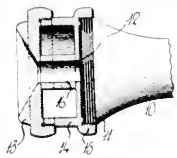
Circular No. 1164 from the Westinghouse Electric and Manufacturing Company is devoted to their type M. S. alternating current polyphase induction motor. This is a constant speed squirrel cage rotor, especially dêsigned for mill service.

Bulletin No. 3765, entitled "Bell Ringing Transformers," from the General Electric Company, illustrates and describes a small transformer for use in connection with the operation of electric call bells, eliminating the usual battery for this purpose.

The General Electric Company in folder No. 3761, entitled "Extension Diffusers," describes a diffuser for use in connection with incandescent lamps designed to meet the demand for an incandescent lamp fixture, embodying aesthetic as well as the scientific principles required for certain high grade incandescent lighting.

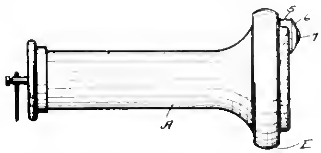
PATENTS

915,625. Telephone Receiver. Alcorn Rector, New York, N. Y., assignor to Rector Help-A-Phone Company, New York, N. Y. The combination with a telephone receiver of the usual type, of a ring interposed between the end of the receiver and its ordinary ear piece, the said ring being adapted to fasten



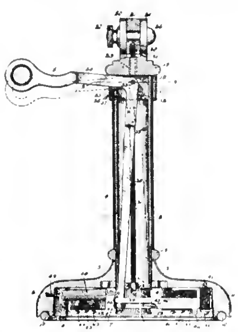
to the receiver over the diaphragm, having its outer end screw threaded to receive the usual ear piece, and having a central sound bore corresponding with the bore of the ear piece.

915,079. Telephone Receiver. James Dixon, Cleveland, Ohio. A telephone receiver having the usual opening therein for delivering sound waves and provided at one side of and a suitable distance from the said opening with a lug arranged



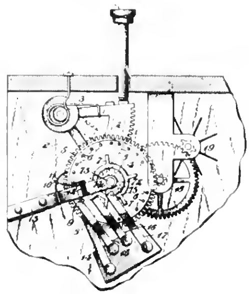
wholly at the said side of the opening and in position to be pressed against the bony structure of the head of a person in suitable proximity to the outer ear of the organ of hearing to which the telephone receiver is to be applied.

915,077. Desk Stand. William W. Dean, Chicago, Ill., assignor to Kellogg Switchboard and Supply Company, Chicago, Ill. In a desk set, the combination with a stand having a tubular standard and a hollow base, of a hook switch lever mechanism within said standard and suitably pivoted near its upper end upon which the receiver is adapted to be suspended, a portion of said hook-switch lever mechanism extending

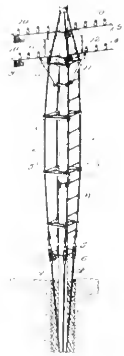


downward through the tubes with its lower end adapted to have a horizontal reciprocating motion, a set of switch springs inclosed by said base and disposed in a horizontal plane to render their contacts visible from beneath, the lower end of said switch-hook mechanism being adapted to actuate said springs by its horizontal movement to control the circuit therethorugh, substantially as described.

915,578. Machine for Recording Telephone Calls. Hermann Fascher, San Diego, Cal. In a telephone call recorder, the combination with the central switchboard and line wires, of connections therewith through receiver switch of subscriber's telephone, a call transmitting mechanism and a call

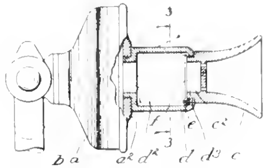


recording mechanism, each of said mechanisms being connected with said receiver switch, and a double source of energy at central for the operation of said call recorder mechanisms.



915,305. Telephone Pole. Eugene J. Newhall, Waupaca, Wis. In combination, a pole, braces secured to the pole at intervals in its length, guys having connection at their upper ends with the pole and deflected by means of the braces, stays having connection at their lower ends with said pole, turn buckles connecting the upper ends of the stays with the lower ends of the guys, and means connecting the turn buckles in series to prevent their movement when properly adjusted.

916,245. Telephone Transmitter Attachment. Richard L. Woodward, Jersey City, N. J. The combination with the main casing and mouth piece of the transmitter of a telephone, of an intermediate casing detachably connected with the main casing and with which the mouth piece is detachably connected, said intermediate casing being provided transversely



of the bottom portion thereof and of the outer end thereof with a rod which projects therefrom at one side and is provided with a handle, and a plate secured to said rod within said intermediate casing and adapted in one position to close the transmitter, said plate and rod being provided with a spring which normally holds said plate in position to close the transmitter.

INDUSTRIAL

TELEPHONE BOOTH FANS.

Everyone is familiar with electric fans and knows what a relief they are in the summer time for offices and for houses, but their use is being extended to another field, where they are as much appreciated. To anyone who has occasion to use long-distance telephone booths at all it will be a source of pleasure to know that the Westinghouse Company is now manufacturing an 8-inch fan which can be used to keep the air in circulation in the booth.

These fans look like a toy; some people have facetiously said they would do for a watch charm, but they are far from being mere toys. The blades spread but 8 inches, while the motor is not half the size. The motor is supported by springs from an arm screwed to the side of the booth, and may be tilted or turned through a wide range of directions. The springs prevent any transmission of vibration from the motor to the telephone, and, as the fan is noiseless, the effect

Telephone Booth Fan.

is to blow the impure air out of the booth and bring in fresh without in any way affecting the use of the telephone. As booths are usually provided with several small holes the air is circulated even with the door closed, but of course the best ventilation comes when the door is opened. This insures users against breathing the same air someone else has just been using. We notice it speedily if it is a man who has been using tobacco, but we are not aware of the contagion that there may be given off by a sick person, whether afflicted with some loathsome disease or with a less dangerous sickness. The fan is kept running all the time and consumes about one-quarter of the current required by an ordinary 16 candle-power carbon lamp. A regulating switch is provided in the base of the bracket from which the motor is suspended, by which the speed may be adjusted to three values, any one of which may be used for running indefinitely. The movement of the air is dependent upon the speed of the fan, as is the amount of power required. In some booths the lowest speed of the fan is sufficient. At the usual rates for power, 10 cents a kilowatt hour, it would cost a cent and a half to run it all day long.

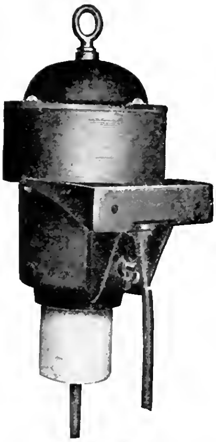
INSULATING TRANSFORMER FOR TELEPHONE LINES.

An insulating transformer for use on telephone lines has recently been placed on the market by the General Electric Company. The purpose of this transformer is twofold:

First—To safeguard the users of telephones from the dangers of high voltages due either to induction or accidental contact between telephone and power lines, where these lines are on the same pole, or upon a parallel adjacent line of poles.

Second—To improve the telephone service by removal of the ordinary small ground gap carbon arrester from direct connection with the line, as well as improvement through better insulation by removing the interior wiring, instrument, batteries, etc., from direct connection with the line.

Special attention has been given to the electrical and mechanical design of the transformer; the high-frequency talking currents are transformed with small loss, while at the same time the magnetizing current, which must be supplied by the ringing generator, is very small. Tests show



Telephone Transformers.

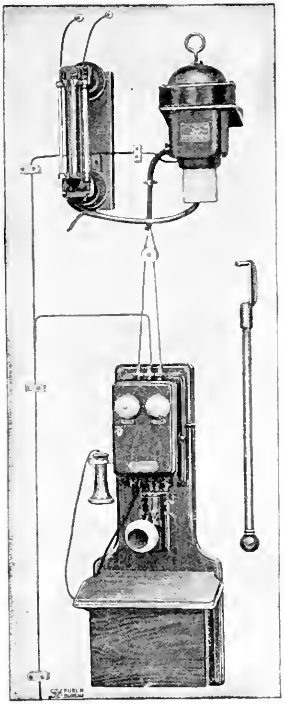
that the magnetizing current taken by this transformer is about half the current passed by a standard 1,000-ohm bell. As can be seen from Fig. 1, the insulating transformer is assembled in a weatherproof iron case and may, if desired, be installed out of doors and mounted in any convenient place.

In designing this transformer the insulation has been considered of primary importance. A high potential test between windings of 25,000 volts for one minute is given to each transformer before shipment. The high insulating quality assured by this test makes the transformer a sturdy piece of apparatus under ordinary conditions of operation, but the best protection is afforded when it is installed with a combined switch, fuse and lightning arrester. This combination affords the greatest safety to both the telephone instruments and the user, even in the most extreme cases when the telephone lines come in actual contact with a high-tension power circuit.

The switch, fuse and lightning arrester combination recommended for this service is shown at the top of Fig. 2, the whole being mounted on a base of insulating material. The long-handled insulated hook at the right of the illustration is used to pull the switch open when it is desired to disconnect the telephone and transformer from the line. The

arrester is hinged at the bottom, the insulated hook engaging with a ring at the top of the arrester. The usual form of carbon arrester with mica separation is used to protect the winding of the transformer against any abnormal difference of potential which might accidentally exist between the telephone lines. This arrester is connected across the terminals of the transformer, but is not connected with the ground.

An adjustable gap arrester is connected between the telephone lines and ground, the function of this arrester being to take care of lightning discharges, and in case of actual contact with high tension lines to arc over and blow the fuse, thus disconnecting the transformer and telephones from the line. Should a ground occur on the adjacent high-tension line the voltage induced on the telephone line will not materially interfere with the service, provided the line is sufficiently well insulated. The adjustable air gap is set just beyond the point where this induced voltage will arc across.



Telephone with Insulating Transformer and Combination Lightning Arrester and Disconnecting Switch.

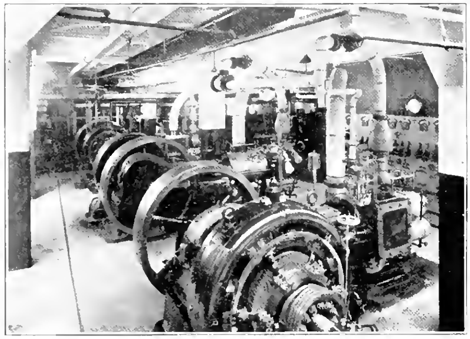
Tests on a 30,000 volt transmission line in actual operation showed that a ground on one phase of the transmission system induced a potential on the telephone line of approximately 7,000 volts, measured between telephone line and earth. Notwithstanding this high induced voltage on the telephone line, it was impossible to use the telephone when the transformer was installed. The line was somewhat noisier than under normal conditions, but not so noisy as to prevent comprehensive conversation.

Bulletin No. 5 from the Kellman Electric & Manufacturing Company, of Los Angeles, shows the Kellman high voltage out-door type oil switches and oil circuit breakers in use.

NEW AGENTS FOR SKINNER ENGINE COMPANY.

The Skinner Engine Company of Erie, Pa., has made arrangements to have their business on the Pacific Coast handled by Henshaw, Bulkeley & Co. of San Francisco, Machinery and Electric Company of Los Angeles and J. M. Main of Portland.

The Skinner Engine Company has been designing and building steam engines for over thirty years. For its product the company claims steam-tight valve economy, practically absolute regulation, automatic oiling and purifying system, accessibility and reliability. They manufacture single valve center crank engines as well as side crank engines of both the single and four-valve type from one hundred to one thousand horsepower. The accompanying view shows an installation of Skinner engines in the Alaska Commercial Building of San Francisco.



Skinner Engines in Alaska Commercial Building.

DEAN ORDERS.

A showing of eighteen switchboards during one working week of six days is the record made by one of the largest Independent manufacturers. The Dean Electric Company advises that during the week ending March 27th, they shipped the following eighteen boards, which is at the rate of three a day: Twelve private branch exchanges arranging from 50 to 200 lines each for use on the Pacific Coast. One 200-line P. B. X. for the Kansas City Home Telephone Company; a 25-line magneto switchboard for Eureka, Illinois; a 100-line board for Everett, Pennsylvania; a 150-line switchboard for Burlington, Kansas, and a 300-line exchange for Delta, Pennsylvania. The other job was a rush order to replace the Fair Haven (Vermont) exchange, which was destroyed by fire on March 16th. The new equipment was ordered the next day and was shipped from Elyria on the 24th, reached Fair Haven, Vermont, the day it was promised on the 26th, and was in full operation on the 28th. An interruption of only twelve days on a complete replacement of a common battery exchange is a record that all Independents may be proud of. The business done by the Dean Company during this week is only an indication of a widespread business awakening.

"Hot Points" for March, 1909, from the Pacific Electric Heating Company of Ontario, California, tells about the great advertising and educational campaign that is to be conducted by this progressive company during the coming summer. It also shows how the electrical dealer will profit thereby in the sale of electric irons. The text is well worth any man's reading from cover to cover.

THE AMERICAN EVEREADY COMPANY.

An example of the wonderful growth in consumption of dry batteries on the Pacific Coast, is shown by the accompanying illustration of the plant of the American Eveready Company, at 745 to 755 Folsom street, San Francisco. The frame building, shown at the left, was erected within thirty days after the fire of 1906, and served as temporary quarters until the erection of the new Class "B" building in 1908. The old building is still being used for manufacturing purposes and with the new building occupies a space of 40,000 square feet. This has still been found to be inadequate and plans are now being prepared for an additional building, giving a floor space of 20,000 square feet.

The great development of the telephone business and all things electrical, as well as the demand for the automobile trade, is responsible for the fact that the American Eveready Company are now producing daily over a carload of dry batteries in their San Francisco factory.

San Francisco Factory of the American "Eveready" Company

In addition to the "Eveready" battery this company has developed a new battery which will be of great interest to all of the telephone companies and electrical trade. This cell, the "Three Crescent" telephone battery, manufactured only at the San Francisco factory, is sold with a guarantee of an initial voltage of 1 6-10, initial amperage from 15 to 18 and a shelf depreciation of only 3 amperes in six months. It has now been on the market a trifle over one year, long enough for a thorough test to have been made in actual use, and the high testimonials of half the telephone companies of the Pacific Coast is a sufficient guarantee that the battery is all that is claimed for it.

In addition to the standard types of dry batteries a complete line of novelty and flash-light batteries is made in San Francisco, and the advantage of coast-made batteries is of even greater importance on the small cells than on the larger sizes, the life of flash-light batteries naturally being shorter in comparison and practically impossible to ship from the Eastern markets on account of the liability of deterioration before reaching the consumer's hands.

When the American Electrical Novelty & Manufacturing Company was first organized, the name was typical, as the principal lines manufactured were electrical novelties, but in later years a great many new and entirely different lines have been added, such as vacuum bottles, speedometers, vulcanizers, automobile starters, volt meters and ammeters, bulldog battery connectors, miniature lamps, etc. For the reason that the old name has ceased to signify any thing, and besides being unsatisfactory on account of its length, it has been decided to change the name of the companies operating in the U. S. A. to American Eveready Company, in England to British Eveready Company, and in Germany to the German Eveready Company. The San Francisco branch being styled the American Eveready Company of the Pacific Coast.

The numerous Eveready Companies have also developed and have now ready for the market something entirely new in the way of a small battery for flash-light use. It is made from entirely different materials and in a different way from the old style cell, and is guaranteed to give more than double the life. It is now possible to produce a pocket flash-light, as small as $\frac{1}{2}$x$1\frac{1}{2}$x2 inches, which used in conjunction with the new Tungsten lamp will give wonderful results in the way of life and recuperation.

Gas engines in Japan represent nearly 15 per cent of the total motors adopted by manufacturers. The number of factories worked by motors in Japan in 1897 was 2,910, none of them using gas or oil engines; the number of factories using motors in 1906 was 4,656, of which 306 were gas and 429 petroleum engines. Consul J. H. Snodgrass of Kobe states sales in these lines, the imports of American gas, petroleum, and hot-air engines amounting to $14,025, while the imports of American steam engines and boilers amounted to $186,119 This is due to the strong competition of Japanese manufacturers, and also on account of the fealty displayed by the average Japanese dealer in behalf of Japanese products. One of the Kobe iron works is manufacturing a horizontal engine of the latest pattern which can be converted into a gas engine. The manufacturers claim that it can be worked with a very small supply of kerosene, and that it is safe, economical, and simply built.

NEWS NOTES

TELEPHONE.

GRAND FORKS, B. C.—The British Columbia Telephone Company will erect a two-story brick building.

SUSANVILLE, CAL.—N. S. McKinsey has been awarded a contract for constructing telephone lines in Lassen county.

MOUNT VERNON, WASH.—The Sunset Telephone Company will install its system in a new building being erected here.

PORT ANGELES, WASH.—C. J. Farmer has been granted franchises at Bremerton, Charleston, Port Orchard and other nearby towns.

MEDFORD, ORE.—The Citizens' Telephone Company has been incorporated here with a capital stock of $30,000, by E. B. Pickel, et al.

PETALUMA, CAL.—W. D. Thomas has been awarded the contract for constructing a private telephone line to the Gugliemetti ranch in Chileno Valley.

PRESCOTT, WASH.—The Colville Spring Rural Telephone Company will be granted a franchise to enter the city and establish an office.

DILLON, MONT.—The Rocky Mountain Bell Telephone Company will spend a large amount of money in improving its lines in and about the city.

TURLOCK, CAL.—J. T. Randolph has been granted a fifty-year franchise to construct telephone and telegraph lines on public highways in this city.

NEWPORT, WASH.—Manager Anderson of the Newport Telephone Company has started construction of the line down the Pend d'Oreille river valley.

EUREKA, CAL.—Superintendent Mortsolf, of the Hoopa Indian Reservation, is now at work completing plans for a telephone line to the Reservation. He plans to have it in operation before summer.

BUTTE, MONT.—The Montana Independent Telephone Company of Butte and the Interstate Telephone Company of Spokane have entered into an agreement whereby a line will be constructed from Mullan, Idaho, to Missoula, Mont.

LOS ANGELES, CAL.—William Dubilier, chief electrician of the Collins Wireless Telephone Company, of Newark, N. J., is now in this city seeking a suitable site to establish a station. A subsidiary concern is to be formed and instruments manufactured.

RIVERSIDE, CAL.—The Corona Union Telephone & Telegraph Company has been incorporated here with a capital stock of $25,000 by J. G. Jameson, E. J. Genereaux, C. M. Scottville, G. E. Snidecor, W. L. Prizer, W. L. Peelerf and D. Lord.

FINANCIAL.

BAKERSFIELD, CAL.—The McKittrick Oil Company has levied an assessment of 1 cent per share on the capital stock of the company.

HANFORD, CAL.—The Lillian Oil & Mining Company has levied an assessment of 6 cents per share on the capital stock of the company.

SAN LUIS OBISPO, CAL.—The See Canyon Oil Company has levied an assessment of 1 cent per share on the capital stock of the company.

SAN FRANCISCO, CAL.—The Clark Construction Company has levied an assessment of 10 cents per share on the capital stock of the company.

OAKLAND, CAL.—The Oakland Oil & Asphaltum Company has levied an assessment of ½ cent per share on the capital stock of the company.

SAN LUIS OBISPO, CAL.—The San Luis Obispo Mutual Oil Company has levied an assessment of 1 cent per share on the capital stock of the company.

SIERRA MADRE, CAL.—Bonds to the amount of $30,000 have been issued by the city council for purchasing property and erecting a gas plant in this city.

SAN FRANCISCO, CAL.—The $16,000,000 bond issue of the Pacific Telephone & Telegraph Company has been offered for sale by J. P. Morgan & Co., New York.

NEWMAN, CAL.—A bond election will be held in this city on May 4, 1909, to decide on the question of issuing bonds, amounting to $20,000, for obtaining a municipal water supply.

SAN LUIS OBISPO, CAL.—At a bond election held in this city this week it was decided to issue bonds to the amount of $180,000 for municipal improvements. Improvements to the water works will be made, amounting to $80,000.

SAN FRANCISCO, CAL.—The daily earnings of the United Railroads are now $19,250, thus making the quarterly earnings approximately $1,732,500. The company's finances are stated to be in better shape than they have been in years.

SAN DIEGO, CAL.—Secretary M. B. Fowler of the San Diego Gas & Electric Company, announces that the company will pay, on April 18, 1909, the principal of its outstanding first mortgage bonds, with interest accrued to that date, at the Wells Fargo-Nevada National Bank, San Francisco, or at the office of the Standard Trust Company of New York.

INCORPORATIONS.

RIVERSIDE, CAL.—The Hannon Water Company has been incorporated here with a capital stock of $5600 by the Hannon family.

LOS ANGELES, CAL.—The Price Well Oil Company has been incorporated here with a capital stock of $50,000 by A. D. Elwell, C. E. Price and F. E. McLeod.

LOS ANGELES, CAL.—The New Castiac Oil Company has been incorporated here with a capital stock of $500,000 by G. W. McBride, W. Sullivan and C. H. Slease.

SAN FRANCISCO, CAL.—The San Miguel Oil Company has been incorporated here with a capital stock of $250,000 by H. A. and A. H. King and M. K. McKevitt.

BAKERSFIELD, CAL.—The Price-Well Oil Company has been incorporated here with a capital stock of $50,000 by A. D. Elwell, C. E. Price and F. E. McLeod.

BAKERSFIELD, CAL.—The T. W. Oil Company has been incorporated here with a capital stock of $100,000 by T. M. Young, T. W. Thomas, H. E. Griffith and E. M. Bray.

FRESNO, CAL.—The Arizona Petroleum Company has been incorporated here with a capital stock of $250,000 by A. A. Adams, W. M. Claypool, A. J. Picknoll and others.

PLACERVILLE, CAL.—The Heddens Mining & Electric Company has been incorporated here with a capital stock of $1,000,000 by Ralph D. Heddens and Daniel R. R. Caldwell.

LOS ANGELES, CAL.—The Pico Oil Company has been incorporated here with a capital stock of $250,000 by C. Astley, L. W. Andrews, J. W. Reeves, J. Ottofy and F. H. Richards.

OAKLAND, CAL.—The Broadway Oil Company has been incorporated here with a capital stock of $250,000 by W. E. Knowles, E. A. Herron, J. P. Taylor, D. C. and H. L. Breed.

RIVERSIDE, CAL.—The Vista Grande Water Company has been incorporated here with a capital stock of $14,000 by A. D. Bell and others.

SAN FRANCISCO, CAL.—The Exploration Oil Company has been incorporated here with a capital stock of $200,000 by I. H. G. Wolf, Dorsey Ash and M. Meyer.

SAN BERNARDINO, CAL.—The Ontario-Upland Gas Company has been incorporated here with a capital stock of $100,000 by B. E. Page, J. R. Anderson, G. W. Anderson and others.

SAN FRANCISCO, CAL.—The Dunfee Electric Company has been incorporated here with a capital stock of $10,000 by C. H. Dunfee, F. Finck, A. J. Shaw, W. W. Shaw and Alice M. Dunfee.

LOS ANGELES, CAL.—The Big Seven Oil Company has been incorporated here with a capital stock of $10,000 by M. L. Morehouse, M. T. F. Johnson, P. V. K. Johnson and H. P. O'Connor.

SALINAS, CAL.—The Alverez Oil Company has been incorporated here with a capital stock of $500,000 by W. H. Stenger, J. L. Chaddock, W. S. Hoyt, S. W. Smith and E. A. Nickerson.

BAKERSFIELD, CAL.—The Eight Oil Company has been incorporated here with a capital stock of $50,000 by E. W. Owen, S. P. Wible, T. E. Klipstein, H. I. Tupman and F. Haberkern.

HOLLISTER, CAL.—The Alverez Oil Company has been incorporated here with a capital stock of $500,000 by W. H. Stenger, J. L. Chaddox, W. S. Hoyt, S. W. Smith and E. A. Neckerson.

LOS ANGELES, CAL.—The Pierpont Oil Company has been incorporated here with a capital stock of $50,000 by William Hardee, G. E. Whitaker, A. B. Canfield, C. B. Barnes and F. W. Black.

SAN FRANCISCO, CAL.—The Uncas Oil Company has been incorporated here with a capital stock of $500,000, by Burke Corbet, Irving Peterson, J. R. Selby, J. M. Wilson and E. V. Whitaker.

LOS ANGELES, CAL.—The Harrison Avenue Water Company has been incorporated here with a capital stock of $33,000 by Earnest Brooks, H. T. Brooks, F. E. Graham, J. B. and Sarah Tuttle.

BAKERSFIELD, CAL.—The Provident-Midway Oil Company has been incorporated here with a capital stock of $250,000 by T. O. Turner, W. L. Wells, L. B. Howe, C. R. Foster and E. D. Foster.

SAN BERNARDINO, CAL.—The Union Gas Company has been incorporated here with a capital stock of $1,000,000 by C. S. Chestnut, D. W. Campbell W. N. Campbell, P. H. Moore and E. M. Massey.

SAN FRANCISCO, CAL.—The Poso Petroleum Company has been incorporated here with a capital stock of $50,000, by George Quarre, H. D. Seine, O. C. Pratt Jr., C. L. Firebaugh and P. E. Mertz.

BAKERSFIELD, CAL.—The Coast Lines Oil Company has been incorporated here with a capital stock of $320,000 by A. E. Wallace, G. J. Wells, C. K. McKenzie, Frank Hansen and G. M. Emerson.

LOS ANGELES, CAL.—The Billiken Oil Company has been incorporated here with a capital stock of $1,000,000 by W. F. Botsford, A. H. Kemper, A. M. Bernum, H. C. Oakley, W. I. Hollingsworth and W. J. Arkell.

BAKERSFIELD, CAL.—The Templor-McKittrick Oil Company has been incorporated here with a capital stock of $3,000,000 by J. H. Hollywood, F. A. Anderson, W. N. Howes, N. F. Wilson, and J. H. Jordan.

TRANSMISSION.

QUINCY, CAL.—The Round Valley Water Company has been granted a franchise to construct electric power lines along the highways of Indian Township.

SAN FRANCISCO, CAL.—Plans are ready for the new electric power plant to be installed in the United States Mint. Director Frank A. Leach is here from Washington, D. C., to superintend the work.

FRESNO, CAL.—The San Joaquin Light & Power Company is to make important extensions of its lines in the near future. A line is to be built shortly out of the Fresno copper mines into the town of Sanger, a distance of 19 miles.

REDDING, CAL.—The electric power plant connected with the Bonanza King mine, in Trinity county, was completely destroyed by fire last week. The plant was uninsured and the loss is stated to be $65,000. The capacity of the plant was 6000 horse power.

RED BLUFF, CAL.—The following water-rights have been claimed on Mill and Deer creeks: C. E. Burris, appropriating 10,000 inches; A. T. Forward, 10,000 inches; J. J. Worthington, 20,000 inches; Leon Blye, 8000 inches; Philip C. Boardman and Charles J. Newman, each 18,000 inches. While nearly all the choice locations are secured there still remains many desirable sites.

SACRAMENTO, CAL.—The Great Western Power Company has announced that it will soon begin to extend distributing lines from the main tower line at New Hope to supply power and light to the farms on the reclaimed lands. The Great Western Power Company of California has organized a subsidiary corporation known as the California Electric Generating Company, to aid in financing the electric steam generating plant now under construction at Oakland. The Great Western guarantees dividends on $2,500,000 of six per cent preferred stock, of which $600,000 has been issued. Common stock to the amount of $5,000,000 has been issued. Bonds of $5,000,000 are secured by a first mortgage on the plant and, further, by $750,000 of the Great Western Power Company's first mortgage bonds. Part of the bonds have already been sold.

TRANSPORTATION.

EL PASO, TEXAS.—Work has commenced on the El Paso-Fort Hancock Interurban electric line.

FRESNO, CAL.—The Fresno Traction Company has been granted a franchise to construct electric lines on certain thoroughfares in tbis city.

LOS ANGELES, CAL.—W. H. Workman has been granted a franchise to construct an electric street railway along certain rights of way in this city.

OAKLAND, CAL.—The Oakland Traction Company has been granted a franchise to construct a double or single track extension of its Thirteenth avenue line to Sausal Creek.

SANTA BARBARA, CAL.—The Pacific Improvement Company has applied for a franchise to build a trackless trolley power line from the Potter Hotel to the Hope ranch, a distance of five miles.

STOCKTON, CAL.—Vice President Morris B. Brackett of the San Joaquin Valley Electric Railway Company, left this week for the New York City to sign bonds whereby the company will secure $500,000 for the construction of the new interurban road to Modesto.

MODESTO, CAL.—The directors chosen for the Modesto Interurban Railroad are as follows: T. N. Beard, G. P. Schafer, H. T. Crow, W. H. Frazine, George Parley, D. E. Saunders and L. L. Dennett. The road is to be 53 miles in length and the first extension from Modesto will be to Waterford and Oakdale, via Empire.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public — the consumer — who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

ADAPTERS

LAMP ADAPTERS

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Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Perkins Elec. Switch Mfg. Co.

ALARMS

BURGLAR ALARMS

Edwards & Co.
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc.
Western Electric Co.

FIRE ALARMS

Edwards & Co.
Partrick, Carter & Wilkins Co.
Western Electric Co.

WATER ALARMS

Partrick, Carter & Wilkins Co.

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Johns-Manville Co., H. W., "J. W."
Kierulff, B. F. Jr. & Co., "Hubbard."
Klein & Sons, Mathias.

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Elec. Goods Mfg. Co., "Ross," "Rivol," "Perfect," "Noxall."
Partrick, Carter & Wilkins Co., "King."
Standard Elec. Wks, "C.&S."
Stanley & Patterson, Inc.
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ARMS

CROSS ARMS

American Cross Arm Co., "Walworth & Neville."
California Pole & Piling Co.
Kierulff B. F., Jr. & Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

MAST ARMS

Elec. Appliance Co., "Cutter"
Ft. Wayne Electric Works.
Kierulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher"

TELEPHONE TRANSMITTER ARMS

Dean Electric Co.
Elec. Appliance Co., "Eaco."
Kierulff, B. F., Jr. & Co., "Sterling."
Sterling Elec. Co.
Western Elec. Co

ASBESTOS

Johns-Manville Co., H. W.

INDEX TO ADVERTISEMENTS

AUTOMOBILE ACCESSORIES
American Eveready Co., "Ever Ready."

BATTERIES
DRY BATTERIES
American Eveready Co., "Ever Ready" and "Crescent."
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Standard Electrical Works, "Standard."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

DRY BATTERY HOLDERS
Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY
Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

STORAGE BATTERIES
Elec. Storage Battery Co.
Westghse Machine Co.

BELLS
ELECTRIC BELLS
Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

ELECTRO-MECHANICAL GONGS
Edwards & Co.
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co.

MAGNETO BELLS
Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

BOILERS
Henshaw-Bulkley & Co.
Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, Edge Moor."

BOOKS
Technical Book Shop.

BOXES
WALL BOXES
Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knock-out."
Chicago Fuse Wire & Mfg. Co., "Union."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
General Electric Co.
Paiste, H. T. Co.
Pass & Seymour.
Sprague Electric Co., "Universal."
Standard Elect'l Wks., "M & M."
Stanley & Patterson, Inc., "Simplex."

BRACKETS
CEILING BRACKET AND DESK FIXTURES
Stanley & Patterson, Inc., "Sunlight."

DESK TELEPHONE BRACKETS
Stanley & Patterson, Inc., "Imperial."

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity Power and Gas *604 Mission Street, San Francisco.*

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.
Journal of Electricity, Power and Gas,
604 Mission Street, San Francisco.

AGENTS WANTED on a guaranteed weekly salary to represent our two publications, "Southern Engineer" and "Southern Machinery"; liberal terms for exclusive services; easy sellers; every engineer and every machinist is interested. Write at once. For further information, address W. R. SMITH PUB. CO., Sub. Dept. Atlanta, Georgia.

WANTED—Men coming in direct touch with Steam, Electrical Superintending Engineers and Shop Foremen. A proposition that can be handled by energetic persons to good advantage. Liberal commission and permanent work. CHAS. L. TURNER, 907 Atlas Bldg., San Francisco, Cal.

SITUATION WANTED—By electrical engineer with 15 years' experience in designing and estimating of electric power plants, switch gears, light, motor and storage battery installations; also in central station service. Advertiser takes also draughting work in this line as home occupation if no steady engagement can be attained. Moderate expectations. Address Box 101, **Journal of Electricity,** San Francisco.

ELECTRICAL ENGINEER with general plant experience wants power plant position as superintendent or assistant superintendent outside of large city where he is at present engaged. Address Box 106, **Journal of Electricity.**

Sterling Elec. Co. "Equipoise."
Western Electric Co

IRON POLE BRACKETS

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Cutter."
Pierson, Roeding & Co.
Western Elec. Co. "Fletcher"

BUILDING CONTRACTORS

Watson, Sidney
Thorpe & Sons, J. T.

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ELECTRIC GAS LIGHTING BURNERS

Edwards & Co.
Electric Goods Mfg. Co., "Advance."
Welsbach Company.
Western Electric Co., "Edwards."

CABLES

SUBMARINE AND LEAD-COVERED

Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
Standard Underground Cable Co.
Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

PAPER INSULATION

Belden Manufacturing Co.
Western Electric Co.

TELEPHONE CABLE

Dean Electric Co.
Kellogg Sw'b'd & Supply Co.
Kellogg, W. E. Co.

CARBONS

ARC LIGHT CARBONS

Brooks-Follis Elec. Corp'n, The, "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The, "I-T-E," "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
Kierulff, Jr., & Co., B. F. "Hartman."
Pacific Electric & Manufacturing Co.
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLAMPS

GROUND CLAMPS

Belden Manufacturing Co.
Bossert Electric Const. Co.
Chase-Shawmut Co., "Shawmut."
General Electric Co.
Paiste Co., H. T., "Perma-Effect."

CLEATS

FIBRE CLEATS

Blake Signal & Mfg. Co.

PORCELAIN CLEATS

General Electric Co.
Pass & Seymour
Standard Electrical Works, "Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Elec. Co., H. D. Sears, general sales agent.
Western Elec. Co., "Thomas"

COILS

ARMATURE AND FIELD COILS

Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Delta-beston."
Westghse Elec. & Mfg. Co.

INDUCTION COILS

Electric Goods Mfg. Co.
Kellogg Sw'b'd & Supply Co
Partrick, Carter & Wilkins Co
Western Electric Co.

SPARK COILS

Electric Goods Mfg. Co.
Western Electric Co.

COMPOUNDS

BOILER COMPOUNDS

Dearborn Drug & Chemical Works.
Johns-Manville Co., H. W., "Magic."

CONDUIT

FLEXIBLE CONDUIT

American Circular Loom Co., "Circular Loom."
Sprague Electric Co., "Greenfield."

RIGID CONDUIT

American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct," "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roeblings Sons Co., J. A. "Navalite."
Sprague Electric Co., "Iron Armored."

UNDERGROUND CONDUIT

American Cross Arm Co., "Walworth & Neville."
Johns-Manville Co., H. W., "J.-M."
Pierson, Roeding & Co., "Fibre."
Roeblings Sons Co., J. A., "Bituminized Fiber."
Western Electric Co., Agents

CONNECTORS

CABLE CONNECTORS

American Eveready Co., "Bulldog."
Belden Manufacturing Co.
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F., Jr. & Co.

CORD

FLEXIBLE BELL CORD

Belden Manufacturing Co.
General Electric Co.
Kierulff, B. F. Jr. & Co., "National."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roebling Sons Co., John A.
Simplex Elec. Co.
Western Electric Co.

LAMP CORD

Belden Mfg. Co.
Elec. Appliance Co., "Paranite."
General Electric Co.
Okonite Co., The, "Okonite."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roeblings Sons Co., John A.
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Standard Und. Cable Co.
Western Elec. Co., "Victor."

TELEPHONE CORD

Belden Manufacturing Co.
Dean Electric Co.
Kellogg Sw'b'd & Supply Co
Kierulff, B. F., Jr. & Co. "National."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Western Elec. Co., "Victor."

CROSS ARM BRACES

Benicia Iron Works.
Kierulff, B. F., Jr. & Co.

WOOD KNOBS

Blake Signal & Mfg. Co.

CLUSTERS

FIXTURE CLUSTERS

Benjamin Electric Mfg. Co., "Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbell."

CUT-OUTS

ARC CUT-OUTS

Bryant Electric Co.
Ft. Wayne Electric Works.
General Electric Co.

INCANDESCENT CUT-OUTS

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
Paiste Co., H. T., "Shaffer," "K. W.," "P. K." "Taplets."

Perkins Elec. Switch Mfg. Co.
Weber Elec. Co., H. D. Sears, general sales agent.
Westghse Elec. & Mfg. Co.

TRANSFORMER CUT-OUTS

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
Westghse Elec. & Mfg. Co.

DYNAMOS

ALTERNATING CURRENT DYNAMOS

Ft. Wayne Electric Works.
General Electric Co.
Standard Engineering Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

DIRECT CURRENT DYNAMOS

Electric Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co.
Standard Engineering Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

ELECTRIC NOVELTIES

American Eveready Co., "Ever Ready."

ENGINES

GAS AND GASOLINE ENGINES

Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Kierulff, B. F., Jr. & Co., "American Diesel Engine."
Tracy Engineering Co.
Westghse Machine Co.

MARINE ENGINES

Standard Engineering Co., "Engberg."

STEAM ENGINES

Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Standard Engineering Co.
Tracy Engineering Co., The
Westghse Machine Co.

FANS

DESK AND BRACKET ALTERNATING CURRENT FANS

Ft. Wayne Electrical Works.
General Electric Co., "G. E."
Standard Electrical Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

DESK AND BRACKET DIRECT CURRENT FANS

Electric Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co., "G. E."
Sprague Electric Co., "Lundell."
Standard Electrical Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

CEILING, ALTERNATING CURRENT FANS

Standard Elec. Wks., "Jandus." "Century."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

CEILING, DIRECT CURRENT FANS

Electric Appliance Co., "Colonial."
General Electric Company
Sprague Electric Co., "Lundell."
Standard Elec. Wks., "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

EXHAUST FANS

General Electric Co.
Standard Elec. Wks., "M. A Co."
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co.

FIXTURES

CEILING, BRACKET AND DESK FIXTURES
Benjamin Electric Mfg. Co.
Dale Co.

MARINE FIXTURES
Benjamin Electric Mfg. Co.
Dale Co.
Electric Appliance Co.
Sterling Electric Co.

SHOW CASE FIXTURES
Benjamin Electric Mfg. Co.
Dale Co.
Johns-Manville Co., H. W., "Linolite."

STAGE FIXTURES
Chase-Shawmut Co., "Shawmut."

FUSE MATERIAL

ENCLOSED FUSES AND FITTINGS
Bryant Electric Co.
Chase-Shawmut Co., "Shawmut."
Chicago Fuse Wire Mfg. Co., "Union."
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W., "Noark."
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

FUSE BOXES
Including Service Boxes, Subway Boxes and Junction Cut Outs for use with enclosed fuses.
D. & W. Fuse Co., "D. & W."
Johns-Manville Co., H. W., "Noark."

FUSE WIRE AND LINKS
Chase-Shawmut Co., "Shawmut."
Chicago Fuse Wire & Mfg. Co.
General Electric Co.
Pierson, Roeding & Co., "Aluminum."

MISCELLANEOUS FUSES
Bryant Electric Co.
General Electric Company
Paiste, H. T. Co., "H & L"
Weber Elec. Co., H. D. Sears Gen'l Sales Agt.

TELEPHONE FUSES
Dean Electric Co.
D. & W. Fuse Co.
Kierulff, B. F. Jr. & Co., "Sterling."
Standard Elec. Wks., "Couch & Seeley."
Western Electric Co.

GOVERNORS

WATER-WHEEL GOVERNORS
Pierson, Roeding & Co., "Lombard."

GUARDS

WIRE LAMP GUARDS
Benjamin Electric Mfg. Co., "Can't Break," "Protectalite."
Hubbell, Harvey.
Welsbach Company.

HANGERS

CABLE HANGERS
Chase-Shawmut Co., "Boston."
Kierulff, B. F. Jr. & Co., "National."
Standard Underground Cable Co., "Nordyke Support."

HEATING MATERIAL

Including Cooking Utensils, Soldering Irons, Sad Irons, Etc.
Elec. Appliance Co., "American."
General Electric Co.
Johns-Manville Co., H. W., "Electrotherm."
Simplex Elec. Heating Co., "Simplex."
Vulcan Electric Heating Co., "Vulcan."
Westghse Elec. & Mfg. Co.

HOODS

STREET HOODS AND FIXTURES
Elec. Appliance Co., "Cutter."
Ft. Wayne Elec. Works.

General Electric Co.
Kierulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co, "Fletcher"

INSULATORS

GLASS INSULATORS
Brookfield Glass Company, "Brookfield."
Elec. Appliance Co., "Hemingray."
Pierson Roeding & Company, "Locke Triple Petticoat."
Roeblings Sons Co., John A., "Knowles."
Standard Electrical Works, "Standard."
Western Elec. Co., "Brookfield."

HIGH-TENSION INSULATORS
General Electric Company
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Ohio Brass."
Pass & Seymour.
Pierson, Roeding & Company, "Locke."
Roeblings Sons Co., John A., "Lima."
Thomas & Sons Co., R.
Western Elec. Co., "Thomas"

PORCELAIN INSULATORS
General Electric Co.
Johns-Manville Co., H. W.
Pass & Seymour.
Pierson, Roeding & Company, "Locke."
Standard Electrical Works, "Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Electric Co., H. D. Sears, general sales agt.
Western Elec. Co., "Thomas"

INSULATING MATERIAL

Belden Manufacturing Co.
Johns-Manville Co., H. W. "Asbestos Wood," "Indurated Fibre," "Vulcabeston," "Monarch," "Phoenix," "Electrobeston."
Kierulff, B. F., Jr. & Co., "Di-electric."
Paraffine Paint Co., Agents "P. & B." Products.
Standard Underground Cable Co., "Ozite"

LAMPS

ELECTRIC ARC LAMPS
Elec. Appliance Co., "Adams-Bagnall."
Ft. Wayne Electric Works, "Wood."
General Electric Co., "G. E."
Standard Electrical Works, "Jandus," "Boulevard."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

FLAMING ARC LAMPS
General Electric Co., "G. I."
Western Elec. Co., "Beck."
Westghse Elec. & Mfg. Co.

GAS ARC LAMPS
Welsbach Company.

INCANDESCENT LAMPS
Brooks-Follis Elec. Corp., "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co., "California."
Columbia Inc. Lamp Co., "Columbia."
Elec. Appliance Co., "Packard."
General Elec. Co., "Edison," "Lowatt."
Johns-Manville Co., H. W., "Linolite."
Kierulff, B. F., Jr. & Co., "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc., Lamp Co., "Sunbeam," "Regal."
Western Electric Co., "Sunbeam" "Regal."
Westghse Elec. & Mfg. Co., "Westinghouse."

MINIATURE LAMPS
American Eveready Co., "Ever Ready."

TANTALUM LAMPS
Bryan-Marsh Co., "Imperial."
Columbia Inc. Lamp Co., "Columbia."
General Elec. Co., "Meridian Tantalum."

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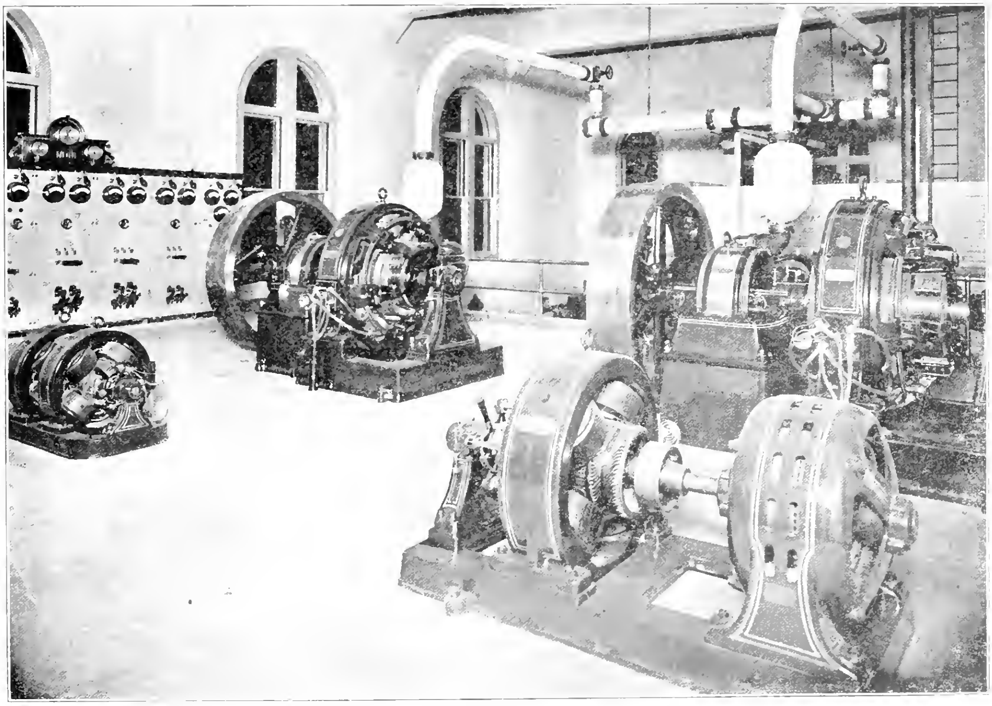
A MODERN HOSPITAL POWER PLANT.

BY C. F. BRAUN

Following the destruction of their old hospital building in the San Francisco disaster, the Southern Pacific Company immediately began plans for a new and larger institution. As a site, an entire block facing on Golden Gate Park was secured, and in February, 1908, work was begun on what is now the most complete industrial hospital in the United States, a hospital capable of caring for over two hundred and fifty patients. It may be interesting to the reader to know that this hospital is supported by the employees themselves, by a tax of fifty cents per month, levied on each and every employee, who in return is insured the best medical care and attendance in case of sickness or accident.


Power Plant of New Southern Pacific Hospital, San Francisco

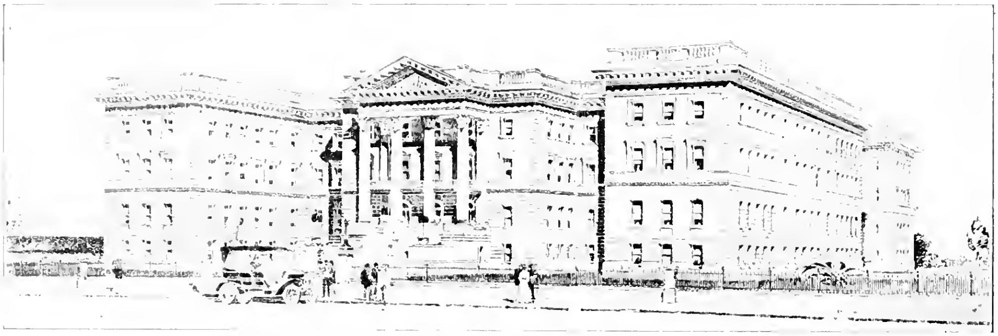
Heat, light, power and water are all supplied by a complete isolated plant, which it is the purpose of this article to describe. The power plant is housed in a modern concrete and brick structure, in which utility and architectural beauty have been harmonized, and as is characteristic of the other parts of the institution, no expense has been spared to give the plant a finished and pleasing appearance. The boiler settings are of

glazed brick, the engine-room floors of maroon tile, the engine finish is exceptionally fine, and all exposed pipe and fittings are of finished brass.

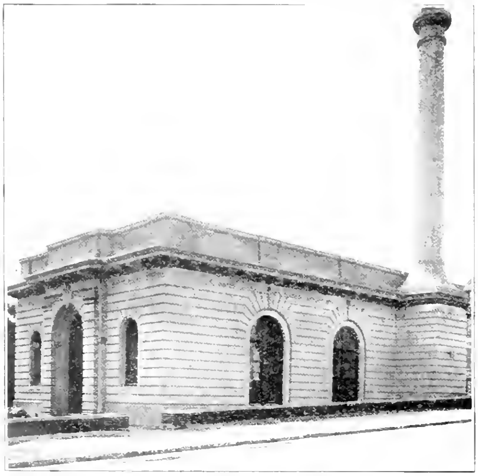
BOILERS.

Steam for the engine-generator units, for the Webster heating system and for hot water service, is supplied by a battery of two 150 h. p. water tube boilers, operating at 160 lbs. pressure. California crude oil is the fuel used, the fuel handling apparatus consisting of two 4½" x 2¾" x 4" duplex steam driven pumps, which draw oil from a large storage tank, 10,000 gals., outside the building footings, passing it through heater and strainer to the burners. The heating of the oil is accomplished by means of a small coil on the outside of which the oil pump exhaust is allowed to pass. A set of five ¼" x 3½" x 5" duplex steam driven boiler feed pumps, a set of 6" x 6" x 12" direct acting vacuum pumps for the heating system, and a 400 h. p. Webster [illegible] heater, complete the boiler-room equipment.

The stack is a part of and harmonized with the rest of the building. It is 36 inches in diameter and 50 feet high, the lower 20 feet being lined with vitribestos tile.



New Southern Pacific Hospital, San Francisco.



Exterior of Power Plant

PIPE TUNNEL.

All pipes from the boiler room to the main buildings are led out through a 4' x 8' reinforced concrete tunnel, which passes on a level from the boiler-room floor directly underneath the engine room, and thence to the buildings. The engine exhausts are led into this tunnel, as are also all drips, and all electric wiring to and from the generator room.

ELECTRICAL DISTRIBUTION SYSTEM.

In view of the demand for direct current by special apparatus and by elevators throughout the hospital, it was decided to install a direct current plant, the distribution to be on a 125-125-250 volt three-wire system. 125 volt high efficiency lamps are used throughout, and elevator and other motors are operated at 250 volts.

GENERATING EQUIPMENT.

The generating equipment is of special interest, in that two-wire 250 volt generators were used, balancing of the three-wire system being accomplished with a motor generator balancing-set and that with this arrangement exceptional regulation and results have been obtained.

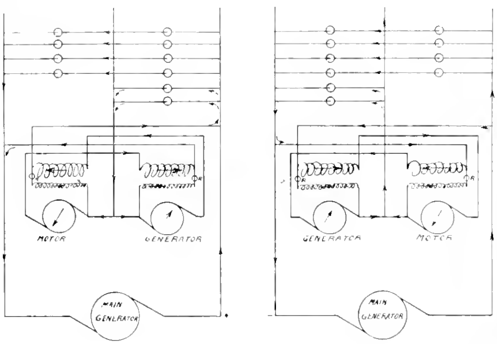
The main generating equipment consists of two 75 k. w. 250 volt two-wire direct current generators, each directly driven by 120 h. p. simple automatic engines running at 275 r. p. m. A 30 k. w. 250 volt two-wire direct current generator directly driven by a two-phase 900 r. p. m. induction motor is provided as an auxiliary, the motor being connected to the local power company's service, which is 250 volt alternating current. The series fields of all three generators are connected in multiple through one pole of each main generator switch, this providing for satisfactory operation of the machines in parallel. The series field coils of the machines are strong enough to give 10 per cent higher voltage at full load than at no load, an adjustable shunt being provided on the series fields for obtaining the desired value. This adjustment may also be used to compensate for drop of speed on the engines. The voltage rise is proportioned to the load increase, making the curve for various loads, approximately a straight line.

The motor generator balancing set, which is connected across the three-wire system, was designed to regulate with a maximum current in the neutral wire of 150 amperes, within two volts, but, it will be seen

later, this figure has been surpassed. The connections for this balancing set are shown in the accompanying diagram. It will be noticed that the shunt field of each machine of the set is excited from the opposite side of the system, this tending to raise the voltage on the low side. The series field of each machine of the balancing set is in series with the armature of the opposite machine, thereby compounding one machine with the armature of the other. Tracing through the direction of current in the various windings, the reader will note that the machine, acting as generator, is cumulatively compounded, while the machine acting as motor is differentially compounded. The cumulative compounding in the generator field tends to raise the voltage on the low side and the differential compounding of the motor field tends to maintain constant speed. Running under unbalanced load the motor takes considerably more current than the generator, and if compounded with its own current, would tend to flash over much sooner than when compounded with a smaller current of the generator; while the generator being compounded with the larger motor current, has a stronger tendency to hold the voltage up. Under test and without any movement of the brushes or rheostats, this set showed the following regulations:

Current in neutral.	Volts, motor side.	Volts, generator side.
0	116.7	116.7
30	117.2	116.3
70	117.8	115.8
130	117.1	115.6
150	115.5	116.9

It is thus seen that the voltage varies from normal but one volt, or less than one per cent, this regulation



CONNECTION DIAGRAM
COMPOUND WOUND BALANCING SET

being obtained through the entire range of the balancing set automatically and without any operation whatever of the rheostats. The machines reverse their functions, passing through zero to the opposite extreme with the same results. This is something, the writer believes, that no three-wire machine will come anywhere near doing. The balancing set has the additional advantage in that for long continued unbalancing on the system the rheostat can be adjusted so that the voltages on the two sides of the system are exactly equal.

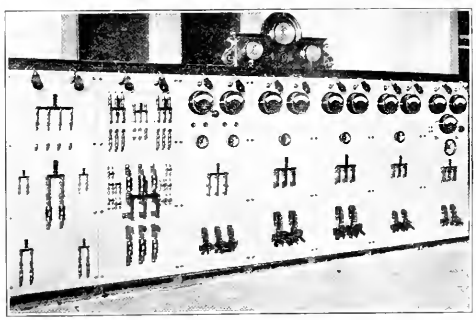
When the decrease in the life of lamps run above voltage and the great reduction of candle power due to low voltage are considered, the value of this close regulation is manifest. For the ordinary 3.1 watt lamp burned at a voltage 2 per cent below normal, Foster gives a corresponding candle power decrease of 11 per cent and wattage increase to 3.34. For the same lamp burned at 2 per cent above normal, a decrease in life of 40 per cent is given. The new high efficiency lamps are not quite so seriously affected, perhaps. The standard regulation guaranteed for three-wire generators is 2 per cent above and below normal.

For operation, the balancer set requires 7.5 amperes. This, however, is offset by the greater efficiency in the two-wire generator over that of the three-wire machine, additional windage and friction in the three-wire machine bringing the efficiency of this type of machine to at least 2 per cent below that of the two-wire machine of equal capacity. When the use of standard two-wire apparatus, simplified wiring, and reduction of first cost are further considered, the superiority of the three-wire generator in any respect to an arrangement such as this, is not apparent. The danger of violent short circuiting encountered in "throwing in" some three-wire machines in parallel, is also eliminated with the use of the balancer. The electrical machinery was built by the Electric Machinery Company of Minneapolis, Minnesota.

SWITCHBOARD.

The switchboard consists of seven panels, three generator panels, a panel for the induction motor, a balancer set panel, and two distributing panels, one lighting and one power. The panels are of uniform size, 30" x 76", of a single piece of blue Vermont marble 2 inches thick.

On each generator panel are mounted a voltmeter, an ammeter, a double pole plain overload circuit break-



Switchboard

er, the field rheostat, and a three-pole knife switch, through the middle pole of which the equalizer lead is connected to the equalizer bus.

On the motor panel are mounted an ammeter for each phase, a voltmeter with plugs and receptacles, a double pole plain overload circuit breaker, a triple pole main switch and a large hand-wheel for operating the motor starter at the rear of the board.

On the balancer panel are mounted a differential ammeter, a differential voltmeter, a triple pole plain overload circuit breaker, the two field rheostats, a triple pole double clip resistance starting switch, and also the ground detector lamps of the system. It will

be noted that the switching arrangement for the balancer set is simplicity itself. The three pole double clip switch serves to start the balancer, cut-out resistance, and connect the neutral, and is absolutely foolproof.

All distributing switches on the lighting panel are double throw, the lower studs being connected to a separate set of busses that are connected to the local power company's alternating current service. Thus, light for the hospital is insured without running any machinery whatever in the plant. If, however, power for the motors are required, the motor generator set must be started. The institution is thus protected even in the case of entire shut-down of the steam plant.

Above the board and supported by ornamental copper work, are mounted the engine-room clock and boiler steam gages. All metal work on the board, including instruments, is copper finished, and the board is in general keeping with the handsome appearance of the plant.

ENGINES.

In view of the fact that all exhaust would be made use of in the steam and hot water systems, a highly economical engine was not particularly desired, but rather a simple engine with good regulation and with few parts to give trouble. American Ball simple engines with cylinders 14" x 12" were installed.

WATER SUPPLY.

To secure a good and sufficient water supply wells were sunk to a depth of about 100 feet. The water was found to be so gritty that an air lift was determined upon as being superior to any form of plunger pump. A small 6" x 8" air compressor, driven by a 5 h. p. motor in the boiler room ,provides the air. The air lift delivers the water to the suction of a 2-inch centrifugal pump driven by a 3 h. p. motor, which in turn forces the water to the large supply tank located on the roofs of the various main buildings. This arrangement has been found to be very satisfactory, the gritty water having no deleterious effects on the air lift or pump runner. The capacity of the pumping equipment is 7,200 gallons per hour.

Great care was exercised throughout to make the plant a model one, D. J. Patterson was supervising architect and the Standard Engineering Company, power engineers, San Francisco, installed the plant, the boilers being supplied by the Parker Boiler Company.

Conservation in California is to be discussed at the meeting of the Counties Committee of the California Promotion Committee to be held May 8, 1909, at Hotel Del Monte, Monterey. Papers are to be presented by Government officials.

Wireless telegraph for the Panama Canal is to be furnished by a station being erected at Porto Bello by the Navy Department. A mast 130 feet high will be erected on one of the hills at the entrance to the harbor. The station will be used for general naval purposes and for transmitting official messages of the Isthmian Canal Commission between Porto Bello and the wireless station at Colon.

THE CONSERVATION OF OUR WATER POWERS.[1]

BY JOHN F. VAUGHAN.

There are two subjects we have heard a great deal about lately: (1) The combining of corporate interests, and (2) the conservation of our natural resources.

Probably the most important example of corporate combination has been in the merging of steam railroads into a few comprehensive systems. This has been followed by a more or less successful movement to consolidate lighter electric railroads, with a tendency further to combine these with the older steam roads. And now in the development of high-tension electrical transmission we have the physical means of combining widely scattered water powers, and in the adoption of electricity as a distributing medium a strong incentive for the combination of interests of all three of these classes: Heavy and light railroads and water powers.

As a matter of fact, the combining of steam and electric railroads has already begun, and now there is scarcely a steam road in the country which is not seriously considering electrification of at least a part of its system, and there are many which are either acquiring or are actually developing water-power privileges to furnish them with motive power. Here, then, among the railroads we find a common interest in the economic development of our water powers.

The second subject—that of the conservation of our natural resources—in its bearing on the welfare of the country is of general interest to railroad men, and as far as it affects the regulation of stream flow is of especial importance to them wherever water power is available. As traffic grows, as train weights and speeds increase, and fuel becomes more scarce and inaccessible, water must be more and more depended upon for power.

The present rate of deforestation, increased as it is by fires set by passing locomotives, in its effect on the reliability of water powers, and on the increase of damage by flood, demands serious consideration.

The following conservative estimate of the water-power resources of the country has been published recently by Mr. Van Schon. He gives the amount of water power already developed as 2,050,000 horsepower, and the available undeveloped power, without the help of storage, as 10,000,000 horsepower.

Now, what are the requirements for the successful development, and why has it not been more rapid? The reasons have been partly lack of available market for the power, partly the excessive cost of development and partly the difficulty of stream regulation. With the old type of water wheel and costly mechanical transmission, it was necessary to use the power at the wheel, and then with perhaps only a part of the fall available without elaborate and costly canal systems. The more recent turbine and yet newer impulse wheel, although utilizing the full head of the fall, have been still hampered by the necessity for using the power near the fall. But now with the growth of electrical transmission not only can remote markets be reached, but powers formerly inaccessible may be developed and operated singly or in groups, for better economy and efficiency. Thus the differing characteristics of power markets may be largely equalized and better

[1] Extracts from a paper read before the New England Street Railway Club.

service and larger returns obtained from the investment.

The best examples of the consolidation of water powers are in the California system, where plants scattered through the mountain canyons feed into common networks of transmission lines, serving large territories with power for railway and industrial plants, pumping, etc., and in some cases delivering the discharged water for irrigation; and the best example of combination of markets is in the great systems of Niagara, delivering power over hundreds of miles of lines for an infinite variety of uses.

We have good examples of the use of water power by railroads in the plans of the Chicago, Milwaukee & St. Paul, which is already making the initial development of some 200,000 horsepower available in 35 miles of the St. Joe River, for operating its trains electrically over the Great Divide, in the electrification of the Cascade tunnel of the Great Northern Railroad, in the conversion of the Harriman lines around San Francisco, in the equipping of the New York Central for operation by Niagara power, and in many light electric railroads all over the country.

Let us see what the principal requirements for the economical use of our water powers are:

Stream flow should be controlled so as to get the maximum energy out of the stream as a whole, and not merely for the benefit of certain isolated plants. For instance, no one plant with storage should be allowed to hold back the natural flow when required by down-stream users who have no storage to draw on, or to flood them with excess water when detrimental to their interests.

The storage facilities of the drainage basin should be developed as far as practicable for steadying the natural flow of the river, increasing the capacities of the various developments and reducing trouble and damage from floods. For instance, since any development over and above the capacity of the minimum dry-season flow of the stream must be relayed by other power, or the excess sold as cheaper secondary power subject to interruption, even an average stream will waste more power than it can use, and a torrential stream, which may flow in flood over one hundred times its low flow, will give up only a few per cent of its total energy. It is evident that expensive storage cannot be accomplished without the co-operation of the power users and an equitable sharing of the expense.

As far as possible various plants should be tied together to feed into a common network of distributing lines so as to utilize the stream flow to its best advantage, to equalize local peaks and irregularities of load, to reduce surplus investment in spare and breakdown capacity, to cut down distribution costs, and to improve the regulation of the system. By such combination the number of units in each plant may be reduced, hydraulic and electric designs simplified, complication of switching and control cut down, and a corresponding saving made in fixed charges and operating costs. In this way many communities may be served which otherwise could not support the burden of individual development.

Arrangement with other power producers should be considered for the interchange of surplus power, especially where the peak demands are not simultaneous. For instance, an agreement between a lighting company and a coal mine in Pennsylvania for the interchange of power up to 2500 kilowatts, where the mine shuts down before the peak of the lighting load, now enables each to reduce its fixed charges on spare equipment and to improve its load factor.

Surplus power during light demand, or surplus water, should be utilized for industrial purposes, such as pumping, electrochemical or metallurgical processes. For example, the electrical recovery of peat from wet bogs and the manufacturing of fertilizers and certain other products of modern chemistry from nitrogen recovered from the atmosphere are not wholly visionary, nor is it necessarily crazy to use surplus flow to pump water into reservoirs above the natural water levels for use during dry periods or excessive loads. In certain localities surplus or discharged water should be utilized for water supplies or irrigation. Groups of plants now on the old series canal systems, or plants otherwise inefficient in the use of water, should be redeveloped.

There are, of course, many obstacles to overcome before our streams can be properly controlled and their power utilized to best advantage; legal tangles to straighten out, franchise restrictions to modify, dams to build and to rebuild, and innumerable physical and operating details to work out. But water is a permanent asset which is neither burned up like fuel nor carted off like our mineral resources, but returns with every fog and rainstorm to be used again.

In the interdependence of the territories embraced by the various watersheds our interests in this asset become national, warranting Federal control, or at least State action under Federal supervision, and already we have in the hydraulic work of the New York State Water Supply Commission, established under the Fuller bill, a substantial advance made in the study of the storage possibilities and in its effect on present and future water powers of the State, and in the National Conservation Commission, appointed by the President, a definite establishment of Government policy. Both of these commissions recognize that the conservation of our water supply is of sufficient importance to call for comprehensive plans of water storage and stream control, and that the Government should eventually distribute the cost of such improvements among all interests in proportion to the benefits received.

On this basis, then, the water-power interests will be required to carry only a burden in proportion to the benefits they receive; and such a policy will not only enable individual enterprises to develop their resources to best advantage, but will give their properties a more definite and permanent value.

In this general movement toward stream betterment there is a definite beginning of a more economic use of our water-power resources, and in the growth of electrical transmission a means of reducing both first cost and operating expense. And from whatever point we view the matter we have plenty of reasons for encouraging the conservation work already begun by the Government and, in addition, plenty of opportunity for studying the improvement of our existing powers and the development of new.

ABSTRACT OF THE AMERICAN TELEPHONE AND TELEGRAPH COMPANY'S ANNUAL REPORT.

A general statement covering the business of the Bell system is included by President Theodore N. Vail with the annual report of the American Telephone and Telegraph Company.

There was a total of 4,364,629 telephone stations connected to the Bell system as against 3,839,000 at the close of the previous year, an increase of 525,629 stations. Of the total there were 1,103,144 exchange and toll stations connected to the Bell system by toll or long distance lines, but operated by some 7,700 local, co-operative, and rural independent companies or associations having sub-license or connection contracts.

The total wire mileage of the Bell companies for toll and exchange service was 9,830,718, over a million miles being added during the year. The daily average of calls handled by the Bell companies was 18,963,000, or at the rate of about six billions a year. The plant additions were $15,824,000 for exchanges, $8,812,600 for toll lines, and $2,000,600 for land and buildings, making a total of $26,637,200. During the past nine years a grand total of $378,472,800 has been expended in enlarging the Bell properties.

During the year $39,736,700 was applied out of revenue to maintenance and reconstruction purposes.

The report shows that the maintenance of the property is well provided for, and that that the plant itself is assuming a more permanent character, due chiefly to the increased proportion of copper wire and underground conduits and cables.

Of the total value of the telephone plants owned by the American Telephone and Telegraph Company and associated companies, real estate constitutes 9 per cent, underground conduits and cables 20 per cent, copper wires and aerial cables on poles 18 per cent, pole lines, not including wires, 26 per cent,—$8,000,000 of this represents ownership of rights of way over private property—iron wires 4 per cent, central office equipment 23 per cent.

The associated operating companies show reductions in floating indebtedness and increases in cash on hand, a net improvement of $5,004,000. The Western Electric Company shows an equal improvement, so that the current and floating indebtedness of the associated companies is well within the limits of current operations.

President Vail shows that the real or replacement value of the Bell plants is largely in excess of all outstanding obligations.

The Bell business as a whole, excluding duplications and treating it as if operated by a single company, showed a substantial improvement. The total earnings showed an increase over the previous year of $7,009,500, the total expenses an increase of $3,101,100. The balance of net earnings was $45,974,000, and, after deducting $11,034,500 for interest and $21,338,100 for dividends, there was left $13,601,400 in undivided profits. The combined balance sheet shows total assets of $680,044,200, with a surplus of $31,759,600, and depreciation and other reserves of $40,480,300.

The earnings of the American Telephone and Telegraph Company also show a decided improvement over last year and every previous year. The net revenue was $18,121,707.26, out of which dividends of 8 per cent were paid, amounting to $12,459,156, leaving a surplus of $5,662,551.26.

There is shown a considerable increase in the number of shareholders, there being at the end of the year 26,370 shareholders with an average holding of 60 each. By means of the issue of the balance of the authorized $150,000,000 convertible bonds, the financing of the company and its associated companies is completed for 1909 and 1910, including the payment of $31,000,000 notes maturing during those years.

The American Telephone and Telegraph Company's relations to the associated companies are explained in considerable detail. Primarily a holding company, it also owns and operates the long distance lines which connect the systems of the associated companies. In addition to these two functions it assumes what might be termed the centralized administrative functions of all the associated companies. The Bell system is one system telephonically interconnected, intercommunicating and interdependent. It was built up on the policy that any one of over 4,000,000 subscribers can talk with any other one within the carrying power of the voice over the wires. New ideas, inventions and methods are examined, perfected, and made universally available.

The report says: "There has not been sufficient distinction between the 'Independents' and the 'Opposition' in the minds of the public. We have no quarrel with either. With many of the Independents we are working in complete harmony, and for all practical purposes our system is a part of theirs and their system is a part of ours." On the other hand, President Vail says that there is a decided tendency on the part of the public to favor consolidation.

In general, the report calls attention to the fact that there are over 70,000 shareholders in the Bell system. The business has shown an increase from year to year, no matter what the prevailing business conditions. The Bell system, under an intelligent control and broad policy, has developed until it has assimilated itself into and in fact become the nervous system of the business and social organization of the country. This is the result of centralized general control exercised by the company, the combination of all local systems into one combined system developed as a whole. There are no other countries where the telephone service occupies the same relation to the public. It is shown that the average rate of this country, taking all classes of service and conditions into consideration, is about the same as the average rate of all other countries. Cheapness is relative to value, not to price. Value in telephone service depends on development, extent of system, certainty and promptness.

In the concluding statement regarding public relations the report says: "During the year we have had many questions before the courts, state commissions, and other public bodies. We have met them in a spirit of absolute frankness and candor. The results have been on the whole satisfactory, and the treatment we have received has been fair and considerate, and we have found an evident desire to ascertain the real conditions and to meet them fairly."

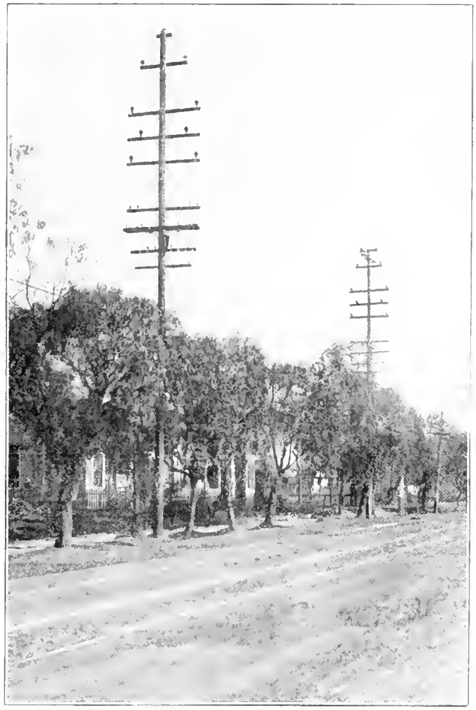
JOINT POLES IN SOUTHERN CALIFORNIA.

BY J. E. McDONALD

In the City of Los Angeles are two telephone companies, three lighting companies and four electric railway systems, all of which are operating independently, having constructed immense distributing systems and branches to many of the outlying towns and cities within a radius of one hundred miles of this southwestern metropolis. Such rapid development was accompanied to a marked degree by the "Pole Nuisance," which is now being overcome to a large extent.

The Old Method.
Five Companies Set Poles Independently on Private Property Lines.

The Joint Pole Committee of Los Angeles is a committee of representatives of the various utility companies, and has for its object the elimination of all unnecessary poles outside of the regular conduit districts established by city ordinance. The Pacific Electric Railway Company, Pacific Light & Power Company, The Los Angeles Railway Company, The Edison Electric Company, The Los Angeles Gas & Electric Company, The Los Angeles Pacific Company, The Pacific Telephone and Telegraph Company, and The Home Telephone and Telegraph Company are actively engaged in this commendable work, as well as a number of outside or subsidiary companies, which participate to a lesser degree. The committee has an organization operating in a measure independently from any of the parent companies, but under the jurisdiction of the authorized members selected by the various companies interested. Combinations are arranged for and recorded through the secretary, who handles the details and provides for an equitable settlement on all combinations. The committee was organized for active work February 1, 1907, and during the two years to date have accomplished a great deal toward bettering local conditions. During this period, combinations have been made on over ten thousand poles in and around the city of Los Angeles, thus eliminating entirely a much larger number of poles which would have been necessary without combination.



An Intensive Combination.
3 15,000-Volt 3-Phase Circuits; 2,200-Volt Primaries With 440, 220 and 110 Volt Secondaries; 6,000-Volt Series Street Lighting Circuit; 500-Volt Railway Feeder; Railway Telephone and Span Wire.

Los Angeles is a city covering a very large area. An extension to outlying sections of the conduit district would be impracticable under the favorable rates given to patrons of the utility companies, and the joint pole proposition has solved this otherwise vexing problem.

Popular agitation with reference to the company's poles has almost ceased entirely since the adoption of this co-operative method, and has helped the companies themselves in making construction better and cheaper, promoting harmony among the operating officials of the various companies, whose business interests must be in direct opposition.

The committee through the secretary relieves the companies of all details relating to joint construction maintaining with each company at an extremely low cost, a duplicate file of all combination work.

DIRECT CURRENT 1200 VOLT RAILWAY EQUIPMENT.

Discussion by members of the San Francisco Section, American Institute of Electrical Engineers, of a paper read by Mr. S. B. McClenegan and published in the Journal of Electricity, Power and Gas, of April 3, 1909. The following took part in the discussion:

C. W. Burkett, Chief Engineer Pacific Telephone & Telegraph Company, San Francisco, Chairman.

S. B. McClenegan, General Manager, Central California Traction Company, Stockton.

Carl Heise, Westinghouse Electric and Manufacturing Company, San Francisco.

R. W. Lohman, Electrical Engineer, San Francisco.

W. J. Davis Jr., Electrical Engineer, with General Electric Company, San Francisco.

Lars Jorgensen, Designing Engineer, with F. G. Baum & Company, San Francisco.

W. W. Briggs, District Manager, Westinghouse Electric and Manufacturing Company, San Francisco.

W. F. Lamme, Construction Department, Westinghouse Electric and Manufacturing Company, San Francisco.

C. L. Cory, Professor of Electrical Engineering, University of California.

H. W. Clapp, Engineer Southern Pacific Company, San Francisco.

A. J. Bowie, Consulting Engineer, San Francisco.

H. W. Crozier, Electrical Engineer, with Sanderson & Porter, San Francisco.

G. A. Hearn, Electrical Engineer, V. B. & N. V. R. R. Company, Napa.

Carl Heise: I have not had any personal experience with 1200-volt apparatus. The Westinghouse Company has never developed that line. Our work has been altogether in the development of the single phase road. Mr. McClenegan brought out one point, which was that the motor generator sets were not fully loaded, and therefore the efficiency of the system was handicapped. That is one of the strong points that we claim for the single phase system inasmuch as, independent of the length of the line, the entire load of the system is on one set, and the set can be proportioned so that the average load on the frequency changer or the station (whatever it happens to be) is high at all times, and the efficiency of the conversion apparatus is therefore pretty high. I do not believe that there is any doubt about the successful operation of 1200-volt apparatus, and the only feature that has ever appealed to most of us is the question of universal application of the system.

R. W. Lohman: Will the author kindly give us some details regarding the 1200-volt generators? Are they two generators in series, or one generator?

S. B. McClenegan: One straight 1200-volt generator, which in appearance is almost identical with the ordinary 550-volt type.

R. W. Lohman: They are driven with a synchronous motor.

S. B. McClenegan: Yes.

R. W. Lohman: How are the synchronous motors started?

W. J. Davis Jr.: They are started as an induction motor, a self-starting motor; it has no starting motor on it.

R. W. Lohman: It might be of interest to say in connection with the third rail construction, that while the speaker spoke of having installed a rail with 400,000 circular mil section equivalent to a 40-pound rail, at a cost of $3,250 per mile, the New York Central type, consisting of 22 pound bullhead rail cost $5,200 a mile or $1 a foot.

S. B. McClenegan: Their conductor is very much heavier than ours—70 pounds; ours is the 40-pound rail. I very much question the use of the rail we have. I think much better results can be got by using the bullhead rail, such as the New York Central employs. That of course was a special rail, the ingredients of which were designed for a conductor. Ours were merely a standard rail. But I think another time a special rail should be got for that purpose.

R. W. Lohman: What form of bond?

S. B. McClenegan: A soldered bond on top of the rail, on the flat side; the bottom of the rail is uppermost, and this bond is laid on top and soldered there. There are no special features in connection with them.

R. W. Lohman: I would like to ask if there is any excess of output.

W. S. Davis: I should not think the load factor on the station at present is over 25 per cent. They are running about 17 miles. With the extension there will be about 25 or 30 miles of road on that sub-station, on which we might expect a load factor of 40 or 45 per cent. We ought to get 15 per cent or better in the efficiency of the motor set, a 500 kilowatt motor generator set, with a load of only one car on it. The load factor is very unfavorable to good economy.

S. B. McClenegan: One-third of the time there is no load on it at all, and of course, the efficiency must be very unfavorable under those circumstances. A single sub-station of 1,200 volts is good for about 20 miles of line, as compared with 10 miles for the ordinary 550 volts.

R. W. Lohman: That is, without feeders.

S. B. McClenegan: Yes, without feeders. There are no feeders employed in our case; it is only the rail itself. As I said, the rail has a capacity of 400,000 circular mils.

R. W. Lohman: Are those operated 1,200 in series?

S. B. McClenegan: 1,200 straight.

Lars Jorgensen: Before rapid progress can be made in superceding steam by electricity on trunk lines, some high voltage traction system is necessary. We have today three different systems of electric traction, none of which in their present state of development would fulfill all requirements necessary to justify the change from steam to electricity. They are, however, all making rapid progress in their development.

The single phase commutator motor is at present a factor in railway engineering problems, especially on account of its promising possibilities of improvements in the near future. The last few years have witnessed the advent of several types of single phase commutator motors, each of which were an improvement of the old induction type single-phase motor without commutator.

The polyphase system is an ideal one in many respects and is also advancing a good deal in development. Its greatest disadvantage is that it requires two trolley wires, which are objectionable, especially at crossing, and its small speed flexibility, if not provided with commutator or other devices which makes the construction complicated.

These two systems have the advantage over the third and most highly developed, the direct current traction system, in greater economy of power transmission. The spacing of the sub-stations can be greater, thereby loading them more uniformly with infrequent train service. While it would greatly improve the load factor to run single cars, it would increase from 100 to 200 per cent the power required to haul a train of a given weight a certain distance, at least at high speeds, where the air resistance is considerable and where the track resistance is also increased.

The 600-volt direct current system has perhaps nearly reached its height of development. At this voltage, however, the sub-stations would have to be spaced close together. The maximum distance apart could not be over between eight and ten miles. With the comparatively infrequent service existing on main lines it would be impossible to obtain any kind of a uniform load; therefore, the average efficiency of sub-station apparatus would be exceedingly low.

With twice the voltage applied to the line the distance to which power can be transmitted with equal economy is four times greater. This will influence the spacing of the sub-stations very considerably and to such an extent that operation of main line trains with 1200-volt becomes not ideal by any means, but practical. At first sight it would seem reasonable to space the sub-stations four times as far apart for 1200 volts as for 600 volts. There are, however, other things than just the

drop in the feeders to be considered, and the proper spacing figures out to be just twice, or between 16 to 20 miles for 1200-volt, If a train is running at least every 20 miles the sub-stations will be uniformly loaded and the 1200-volt direct current system will answer the purpose.

The 120° volt direct current motor is as efficient and as light for a given temperature rating as the 600-volt motor and the commutation is even improved in the 120° volt motor, at least in large sizes on account of the decreased current. The total brush surface will be correspondingly reduced, thereby making greater space available for armature and windings and motors of larger capacity can be mounted on standard trucks with given driving wheel diameter and gear ratio. This is an important point in favor of the 1200-volt system, when considering trunk line electrification, where a large amount of power is necessary.

The Chairman: Have we any other remarks on this subject or questions to ask? I would like to hear from Mr. Briggs on this subject.

W. W. Briggs: I am afraid I cannot add much to what has been said, as I am as much in the engineering field as in the electrical field. I might have more to say if I had known what was going to be discussed tonight. I have not had a great opportunity to really realize what was going to be presented. I am impressed with some of the statements that Mr. McClenegan made with reference to economy, but I do not believe that we would suffer by comparison. However, I do not want to bring up any discussion, commercial discussion.

The Chairman: That is what we are here for. Anything to do with engineering?

W. W. Briggs: We had a paper presented here on the alternating system and there was a large silence on the proposition of load factor on the single road. On the natural load the load factor has been improving right along, and as a consequence an improvement in the current consumption. There is still improvement to be made there yet in the gear rate of their motors. I think in a great many cases in the roads installed in the West that they have not taken that into consideration as much as they should have done in laying out their plans. The tendency is to lay out now high speed and then accelerate all the time. That is principally owing to the fact that the motormen would coast down hill with a low gear and would be liable to throw his armature bearings off and tear up his motor. Those conditions are all being properly met, and I think the 1200-volt direct current has got its place as well as the alternating, and it will only be a short time before they will fit into their particular spheres. The winter that Mr. McClenegan's system has gone through, this last winter, was a very trying one and he ought to be congratulated on the results secured. If the wetness down here may be counted for anything, they must have had much more in Stockton.

W. F. Lamme: I really did not know how the subject was going to be treated, so I am not prepared at all for that reason. However, we engineers like figures, we like to be a little exact if we can. In the last two years the engineers had been very active in gathering figures. There is one instance in the United States where we can make a comparison between a 1200-volt direct current and an alternating current railroad. That line is about 40 miles long, and the termini are in the same town. In the one instance they have 1200 volts direct current and in the other alternating current single phase. The comparative first costs are about in the ratio of five to four, that is, the direct current costs five dollars, whereas the alternating current costs four dollars. The operating costs are about four to three—the 1200-volt costs four dollars, where the alternating costs three dollars. The energy at the switchboard—a little more exact, is 58 for the direct current and 38 alternating current.

S. B. McClenegan: May I ask the gentleman how his maintenance charges were?

W. F. Lamme: We have no figures on that subject as yet, at all. The 1200 volts has only been running a very few months.

S. B. McClenegan: You have had no losses?

W. F. Lamme: No. I have gone as far as we could. What I mean is, that we have had no maintenance charges on the 1200 volts as yet.

R. W. Lohman: Now that the conversation has veered around to the question of economy, the author of the paper said that with the G. E. No. 73 on the 600-volt direct current the power consumption averaged 5.23 kilowatt hours per mile, and with the G. E. 205 on the 1200 volts it was 4.74. If the power weighs 35 tons that reduces it to 84 and 95 per kilowatt hour per ton mile with an efficiency on the alternating current to the car of 60 per cent; 84 and 95 per kilowatt hour would seem to be a little high unless the number of stops were considerable. Have you made tests?

S. B. McClenegan: I cannot say. But we have an excessive number of stops to make. I suppose we stop in a run of 15 miles from 15 to 20 times sometimes.

W. J. Davis: Sixty per cent is a trifle high for this system, inasmuch as you have a 500 kilowatt generator set operating about two cars. I should think that 45 or 50 per cent would more nearly represent the average efficiency of the system; probably less than that; and that would bring the watt hours per ton mile to as much as you would expect under ordinary conditions.

R. W. Lohman: Take the generator at 90 and the motor at 90 and the line at 80.

W. J. Davis: You are running a set sometimes for 15 minutes or no longer with no load and then one car will go on and two cars for a little while, so that an efficiency of 70 per cent for the motor generator set I should say would be probably higher than we are getting. With the 1200-volt system there is a saving in losses in the distributing system which would probably amount to five to eight per cent.

The Chairman: I am disappointed that Mr. Babcock, the electrical engineer of the Southern Pacific Company, is not with us tonight. He has done a great deal of work in the last few years in this electric traction matter—in fact, he is the man up against the job, and those men should give us an interesting story. Professor Cory is with us tonight and we would be favored by a few remarks from him.

C. L. Cory: I wish to say that I was very much interested in the relation of the actual experiences of a man who can view the operation of a railway system, not only from the purely engineering standpoint, but also perhaps from the broader standpoint which I dare say is ultimately reduced at the end of the year to dollars and cents rather than to anything else.

Of course we have here a road that is not exactly typical of the use of high voltage current; in other words, as it is operated today, with comparatively short mileage, it is not what might be expected from a road with two or three or four times a mileage with a corresponding increase in the number of cars.

We cannot get away from the fact, as has been stated very definitely this evening, that from the standpoint of feeders, if we increase the voltage from six hundred to twelve hundred we are really increasing distances by the square of the increased voltage or four times. We are then beginning to get into the field of the high voltage transmission, which of course has been so peculiarly adapted to alternating current; and inasmuch as the single phase motor seemingly at the present time is permanently the variable speed motor of the alternating current system; the single phase railway system that has been developed and has at least two lines in operation in this state, it is a question as to where the advantages of one will begin to give way and become minor as compared to the advantages of the other. There can be no doubt of the thorough reliability and very small maintenance cost of our old five hundred to six hundred volts direct current fraction system. One point that interested me this evening was regarding the use of these 1200-volt motors in systems on the straight 500-volt or 600-volt trolley, as regards the matter of speed. We all have to deal with the problem of rapid transportation. No transportation system of any character, no matter what the motive power may be, can succeed unless when you get into the suburbs you can get the

people over the ground quickly. We can talk about our peak load for our power plants and our lighting plants all we please, but there is not any system that has its peak load so definitely fixed as the transportation company. Those of you who are ferryboat chasers, like myself, cannot help but realize the problem before the transportation companies across the bay is to meet the work concentrated in the period from perhaps five o'clock until six. Otherwise, the equipment, boats, cars, power stations and everything else is ample for a very much greater capacity or income than the situation might perhaps on the face indicate. We must get people quickly from the business district to the residence district, and it is a question as to how this can best be accomplished. I dare say most of you are familiar with the very extensive system in and around Los Angeles. For instance, from the city of Los Angeles to Long Beach, with its double track, high speed service, also the system of transportation between Los Angeles and Pasadena, and Los Angeles and Santa Monica and Redondo, and so on. There the old five hundred or six hundred volt system is in effect. But the midway point is rather clearly shown by the double voltage or 1200-volt direct current system. I think that engineers and financiers both must at all times be grateful to people who go about things like the early pioneers in transmission in California went about things and also like the Central California Traction Company went about it, with absolutely no precedence whatever; with all the chances to be taken for difficulties, they adopted a rather novel third-rail system for a high voltage, 1200 volts, direct current system. The same thing is true regarding those investors and financiers and engineers that are responsible for the alternating single phase system. Those of you who can remember as far back as the first picture that was shown us tonight, of the horse riding down hill on a car, can remember the maintenance charges of the 500-volt Sprague system was about 150 per cent of the gross receipts of the road. It must be admitted that the maintenance charges are perhaps excessive in some roads that are being developed as new lines, but that is not an impossibility to overcome, providing the principle of operation and the possibilities are there.

One thing which interested me this evening is this matter of load [illegible] have a sub-station running for a large [illegible] and then a sudden [illegible] we cannot possibly [illegible] demand all [illegible] We [illegible] storage battery [illegible] would not have [illegible] we could [illegible] for 1200 volts, but [illegible] forthcoming if the saving could [illegible] when we [illegible] suggested [illegible] the current 1200 [illegible] system [illegible] simple problem.

[illegible] I have been very much interested in the [illegible] this evening of this road. I have known [illegible] very much. It is only by [illegible] knowledge, and when [illegible] this evening from Mr [illegible] grateful for it.

[illegible] Mr. [illegible] Mr. Clapp [illegible] I expected [illegible] series. [illegible] What [illegible]

one instance, to 600 volts direct current, and in the other instance, to 1200 volts. I think the great drawback on single phase has been, besides a good many first costs that do not seem to be brought out always—such as heavy weight of equipment and necessarily high-class roadbed—the most vital point in it is the very high operating cost, not due to current consumption, maybe, but due to high maintenance, that led them to discharge it in favor of higher voltage direct current. I have not anything to say in regard to our own experience here, because I am in the hands of our engineers.

Carl Heise: With reference to that point of maintenance I would just like to say that I had a report yesterday from the engineer of the Napa road that the last equipment we furnished had made 200,000 train miles without a cent of cost for repairs. As far as the motors themselves were concerned and the control apparatus, it has done something like 150,000 miles and there was only one interruption of service, which was fixed up in ten minutes.

A. J. Bowie: With reference to high cost of maintenance I would like to ask Mr. Clapp of what that consisted, what items?

H. W. Clapp: The high cost of maintenance was largely in car equipment and up-keep generally, motors and accessories.

A. J. Bowie: In the commutator?

H. W. Clapp: In the motors generally.

The Chairman: Mr. Crozier has had considerable experience in electric traction and we would like to hear from him this evening.

H. W. Crozier: In the first place I would like to ask a couple of questions about the car miles. Do I understand that that consumption of 47.5 kilowatt hours was all on 1200 volts or was the car running part of the time on 1200 and part of the time on 600?

S. B. McLenegan: That was all on 1200 volts.

H. W. Crozier: Did you have any freight or anything else like that?

S. B. McLenegan: That was handled separately. The power used by the express and freight service is not considered in the passenger service.

H. W. Crozier: What I am trying to get at is how you segregated that?

S. B. McLenegan: I do not do that myself, Mr. Crozier, and I am hardly able to answer.

H. W. Crozier: I will explain. I had an exactly similar set of some figures that were made on an alternating current road. The alternating road at Napa was investigated by a committee and the committee made a test and we obtained a showing of 157 watts per mile. That included everything. The case you stated was 137 watts per ton mile, and I would like to make the comparison. Do I understand that this measure of 47.5 kilowatts per ton mile was made on the alternating current side?

S. B. McLenegan: On the alternating current side. That included the track losses as well as the power consumed at the power house.

H. W. Crozier: Everything? How did you get the mileage result from your car result? How did you decide how much power was used by the freight and how much by the passenger?

S. B. McLenegan: That is a matter that our electrical people do, and I am not familiar with the method they arrive at it, except that it is carefully segregated.

H. W. Crozier: The point I want to make is that I am very much surprised at the figure 137, and I am just wondering if the report is not [illegible].

S. B. McLenegan: Of course, as I explained, you have me somewhat [illegible] you know I am not an electrical engineer.

[illegible] which [illegible]

S. B. McLenegan: Yes, on the alternating current side.

H. W. Crozier: [illegible] and what I was trying to get at was [illegible] did you consider how much power the locomotives and everything else used?

S. E. McGeorge: We know the number [illegible] they operated and [illegible] the express cars are not operated on the same [illegible] as the passenger cars. As I say, I did not personally make these [illegible] and I [illegible] to tell you how Mr. [illegible] arrived at it. I would be very glad [illegible] and if you are [illegible] in the matter I would be very glad to have him discuss it.

H. W. Crozier: I would be very glad to see that, because wherever you put [illegible] the watts per ton mile [illegible] I want [illegible]. We have [illegible] difference in the world. The measurement [illegible] station was so different from the others.

[illegible]

THE JOHN FRITZ MEDAL PRESENTATION CEREMONY

[illegible] Mr. Charles T. [illegible] Hon. Mem. Am. Soc. M. E., for his work in advancing the knowledge of steam engineering and [illegible]

[illegible] Engineering Societies Building, No. [illegible] West [illegible] Street, New York [illegible]

[illegible] represent [illegible]

The [illegible] of Modern [illegible] Steam [illegible] —Dean W. F. M. Goss [illegible] Mem. Am. Soc. M. E. and Am. Inst. E. E.

The [illegible] of the Modern Steam Engine [illegible] Mr. Charles T. [illegible] —Prof. F. R. Hutton of Columbia University, Hon. Sec. Am. Soc. M. E.

The Development of the Era of Steel [illegible] the High Speed Steam Engine.—Mr. Robert W. Hunt of Chicago, Mem. Am. Soc. C. E. and Past Pres. Am. Soc. M. E. and Am. Inst. M. E.

The Development of the Era of Electricity [illegible] the High Speed Steam Engine.—Mr. Frank J. Sprague of New York, Mem. Am. Inst. M. E. and Am. Soc. C. E.

JOURNAL OF ELECTRICITY
POWER AND GAS

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Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electricity in the Hospital

Not least important of the uses of electricity is its application in the alleviation of pain. The description of the power plant for the new hospital of the Southern Pacific Company in San Francisco is interesting to electrical engineers, but the fact that the electric current is now being used to palliate the sufferings of hospital patients concerns us all.

First in hospital service is the question of light, and in this regard every precaution has been taken to insure a continuous as well as complete service. Light is not only a matter of convenience, but it also obviates that inherent dread of being sick in the dark that is common to all. In this installation comfort and convenience is insured by the use of electric elevators and electric heating appliances. Safety is provided by the means of numerous electric calls, so at no time can the patient be out of direct communication with the nurse.

The institution is said to be the most complete industrial hospital in the United States, and stands as a monument of the thoughtfulness and skill of the surgeon as supplemented by the ingenuity of the architect.

Rate for Charging

With the increase in sales that has followed the organization of the Pacific Coast Electric Vehicle Association and bodies of like character throughout the country, there has arisen the question as to the proper price to be charged for charging storage batteries. It does not seem fair that the same flat rate should apply to all machines, no matter what the battery resistance or degree of exhaustion. Rheostat losses are greater for batteries with a small number of cells than with those whose counter electro-motive force approximates that of the charging current. It does not seem just that the man whose battery requires a partial charge should pay the same price as the one to whom a full charge is delivered.

To solve this difficulty it has been proposed that the rate be based on the mileage, but this does not seem as logical as would be a basic charge per kilowatt hour, the scale being so adjusted that large users may get a wholesale price. This not only protects the garages against loss, but also is an assurance that each machine gets for what it is paying.

The further question of establishing a uniform rate for maintenance is one that concerns only garages in the same community. It is one to be decided by mutual agreement in accordance with local conditions. As noted elsewhere, these questions are being agitated by members of the Pacific Coast Electric Vehicle Association and require concerted effort for standardization.

PERSONALS.

H. S. DeLancie has joined the San Francisco office of the Westinghouse Electric & Manufacturing Company.

W. S. Berry, with the San Francisco office of the Western Electric Company, has returned after a four weeks' trip East.

Clem A. Copeland of Los Angeles is temporarily filling the chair of professor of electrical engineering in the University of Montana, Missoula, Mont.

A. E. Wood, formerly with the Trumbull Electric Manufacturing Company, is engaged in construction work for the Northern Pacific Irrigation Company, at Seattle, Wash.

J. G. White & Co., engineers and constructors, have opened a branch office in the Alaska Commercial building, San Francisco, under the management of Mr. Henry A. Lardner.

J. E. Wickstrom, who has been with the Seattle-Tacoma Power Company, Seattle, Washington, for the past two years, has opened an office in the Central building, Seattle, as consulting engineer.

Otto Niesser, manufacturers' representative of Los Angeles, has returned from a trip through the Northwest and is spending a week in San Francisco. He is planning to leave for Los Angeles early next week.

L. D. Hitzeroth has resigned as electrical engineer of the Century Electric Construction Company, San Francisco, to become superintendent of power houses for the Nevada-California Power Company, at Bishop, Cal.

Mr. Frederic P. Vose, an attorney of Chicago, and national secretary of the Electrical Trades Association, is in San Francisco and will be in attendance at the annual meeting of that association, which takes place on April 17th.

K. McCaskill, for two and a half years in the electrical engineering department of the New York Central & Hudson River Railroad Company, is now in the service of the Southern Pacific Railroad in the electrification of their suburban branches in Oakland, Alameda and Berkeley.

F. C. Sievers, formerly with the San Francisco office of the Crocker-Wheeler Company, is now a member of the San Francisco sales force of the Fort Wayne Electric Works. Owing to the increase in the business of the Fort Wayne Electric Works, the Sprague Electric Company and the Northern Electric Manufacturing Company, these interests have been compelled to increase their office space and are now occupying the entire fourth floor of the Atlas building, San Francisco.

NEWS OF THE STEAM ENGINEERS.

On Wednesday evening, April 7th, the Educational Committee of California No. 3, National Association of Stationary Engineers, favored the members with an interesting and instructive talk on electric motors, by Mr. J. Henry Klinck of the Westinghouse Electric & Manufacturing Co.

A general explanation of the action of the electric motor was given by means of sketches showing the necessary relation between the magnetic fields set up by the armature and field windings to cause rotation and the necessity for the commutator for the direct current motor shown.

Passing to the alternating current motor the method of obtaining the rotating field was outlined and the action of this field on the winding of both squirrel cage and polar-wound secondaries shown. Emphasis was laid on the fact that in the alternating current motor of the cage wound type there is no necessity for any moving or exposed contacts as the current in the secondary winding has no direct connection with the source of supply. The only parts of this motor subject to wear are the bearings and proper design obviates any danger from this source. The use of starting devices for motors was briefly touched on.

Various motor ratings were explained and the reasons for giving a motor a certain horse-power rating of one kind of service and a different one for another class shown. Speed-load curves of the various classes of windings of both alternating and direct current motors were shown and a parallel drawn between the behavior under various loads of constant speed motors and the automatic steam engine and the simple steam engine operating without a governor under the same conditions.

In conclusion it was stated that only by making a careful study of the conditions under which a motor is to operate is it possible to select the proper type of motor to use to meet all requirements.

(a) CONSTANT SPEED MOTORS in which the speed is either constant or does not materially vary, such as synchronous motors, induction motors with small slips, ordinary direct current shunt motors and direct current compound wound motors, the no load speed of which is not more than 20 per cent higher than the full load speed.

(b) MULTISPEED MOTORS (two-speed, three-speed, etc.) which can be operated at any one of several distinct speeds, these speeds being practically independent of the load, such as direct current motors with two armature windings and induction motors with primary windings capable of being grouped so as to form different numbers of poles.

(c) ADJUSTABLE SPEED MOTORS: (1) Shunt Wound Motors in which the speed can be varied gradually over a considerable range, but when once adjusted, rmains practically unaffected by the load; such as motors designed for considerable range of speed by field variation. (2) Compound Wound Motors in which the speed can be varied gradually over a considerable range as in (1) and when once adjusted, varies with the load similar to compound wound constant speed motors or varying speed motors, depending upon the percentage of compounding.

(d) VARYING SPEED MOTORS or motors in which the speed varies with the load, decreasing when the load increases such as series motors and heavily compounded motors. Examples of heavily compounded motors are those designed for bending roll service and mill service, in which a shunt winding is provided only to limit the light load operating speed.

GOLF TOURNAMENT OF THE JOBBERS.

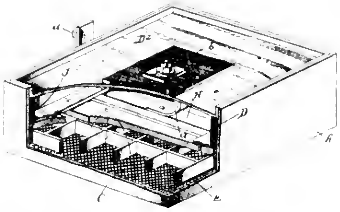
The Electrical Jobbers' Association of the Pacific Coast will hold its next meeting at Del Monte, California, on April 24th, 25th and 26th, at which time a second golf contest for the Del Monte cup will take place. The cup, which is a handsome trophy of burnished copper with silver mountings was won at Del Monte on January 17th by W. L. Goodwin of San Francisco and it is to remain in his possession until some player of superior ability or greater fortune can wrest it from him. The schedule of handicaps has been based on the play of January 17th and the coming contest promises to be of great interest.

ELECTRICAL TRADES ASSOCIATION.

The annual meeting of the Electrical Trades Association will be held at the Hotel Argonaut, San Francisco, on April 17th. In connection with this meeting a luncheon of the members will take place at one o'clock, to be presided over by Mr. Albert H. Elliott, Secretary. Five minute talks will be given by several of the members as well as some representative people outside of the association, who have been invited to be present at the luncheon as guests. The presence of Mr. Frederic P. Vose of Chicago, the national secretary of the association, will add materially to the interest of the meeting.

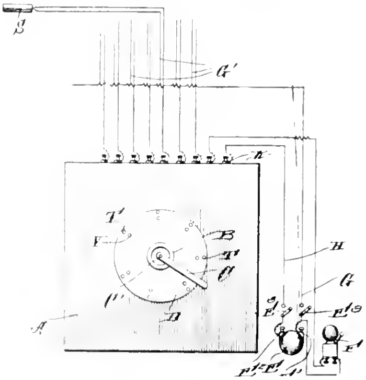
PATENTS

916,575. Secondary Battery. William Morrison, Chicago, Ill. In an electric reversible galvanic battery in which there is a suitable alkaline solution, zinc as the positive active element, a negative-pole electrode disposed at or near the bottom of the cell in substantially a horizontal position so that gravity tends to cause the active material to remain in contact with the negative-pole electrode, and a positive electrode above the negative-pole electrode, together with mercury in contact



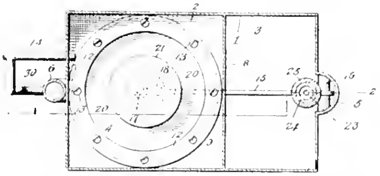
with the negative-pole electrode, the mercury reamalgamating the negative-pole electrode in each successive charge, and insulating means between said electrodes adapted to subdivide the body of electrolyte therebetween, said zinc being greatly in excess of that which the electrolyte can dissolve, whereby the excess of zinc is oxidized by said electrolyte without dissolving, thereby producing an electric current.

916,476. Electrical Shot-Firing Machine for Mines. Walter B. McLarty, Wilburton, Okla. An electric shot-firing apparatus for mines, comprising a generator, a rotatable controller arm, circuit closers mounted upon said arm, means for operating the latter, a conductor ring against which one of



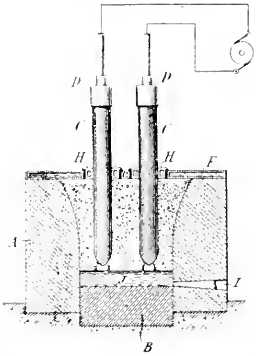
said closers is constantly in contact, electrical connections between said conductor ring and source of energy, a series of contact points against which the circuit closers upon said arm are adapted to contact at predetermined moments, electrical connections between said contact points, the source of energy and the charges to be fired, and an electric signal in the circuit with said ring.

916,943. Gas Pressure Regulator. Roy A. Doane, Palo Alto, Cal., assignor of nine-twentieths to N. B. Nelson, Palo Alto, Cal. In a pressure regulator, the combination of a casing having a partition provided with an opening, a diaphragm secured over the opening in the partition to separate the casing into a gas chamber and an air chamber, the air chamber having an air vent opening and the gas chamber having an inlet and an outlet, an inlet pipe projecting through the inlet opening in the casing, said pipe being internally screw threaded and having its projecting upper end externally threaded, the lower end of the pipe within the gas chamber having a smooth bore and a slot in one side, an externally



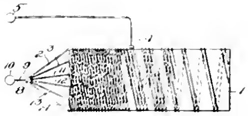
threaded tubular valve seat arranged in the internally threaded portion of the pipe, the lower end of said valve seat being cone-shaped and disposed opposite the slot in the lower end of said pipe, a lever within the gas chamber fulcrumed at one end and pivotally connected at its other end to said diaphragm, a valve fixed to the lever intermediate its ends and adapted to project into and be guided by the smooth bore of the lower end of said pipe, and a packing upon the top of the valve to engage the cone-shaped lower end of the adjustable valve seat.

916,793. Production of Silicon. George O. Seward, East Orange, N. J., and Franz von Kugelgen, Holcombs Rock, Va., assignors to Virginia Laboratory Company, New York, N. Y. The process of producing silicon by subjecting a porous



mixture of silica and carbon to the heat of an electric arc, whereby said mixture is reduced and the silicon is volatilized, while maintaining the arc deeply buried under such mixture, whereby a cooler zone is maintained around the zone of reduction in which the silicon vapor is condensed.

916,541. Variable Inductance Winding. Melville Eastham, Boston, Mass., assignor to Clapp-Eastham Company, Boston, Mass. In a variable inductance winding, a plurality of inductance wires wound in parallel side by side, and a contact



movable transversely of the turns of said winding into circuit-closing relation with adjacent turns of said wires successively, the arrangement being such that no two turns of the same wire shall at any time be bridged by said contact.

THE PACIFIC ELECTRIC VEHICLE ASSOCIATION.

The campaign to develop the latent possibilities of the electric vehicle, which was launched less than two months ago, has met with a hearty support, not only from the dealers but also from the central station men who are progressive enough to see the opportunities for equalizing their load. This movement, which had its inception in the West with the organization of the Pacific Coast Eelectric Vehicle Association, has subsequently developed in Boston, Cleveland and Chicago with the perfection of similar organizations.

From Boston comes the "Electric Vehicle and Central Station," an attractive monthly magazine "devoted exclusively to the electric vehicle and its motive power." Many of the electrical papers of the country are devoting considerable space to the subject, as are also a number of daily newspapers. An example of this is shown in the accompanying clipping from the Seattle Post-Intelligencer, "Treat a Battery as You Treat a Horse," and in the advertisements of the Portland Railway Light and Power Company in the Portland papers advising people to use electric automobiles for city and suburban use.

The chief work accomplished by the Pacific Coast Electric Vehicle Association thus far has been in advising its members of prospective purchasers. The association has at its command men experienced in the construction and operation of electric vehicles, and members are solicited to submit any questions or problems which have bothered them; these will be answered in the Question and Answer Department.

Plans are being laid for a meeting of the association in Seattle during September or October. In addition to the large number of vehicles in regular use in the Northwest there is to be quite an exhibit of electric vehicles and motor boats at the Alaska-Yukon Exhibition and members in the Northwest are enthusiastic as to the good that can be accomplished by such a meeting.

The question has arisen as to what is the proper rate for charging. It is proposed that a uniform scale be established and maintained; many are in favor of a sliding scale based upon the kilowatt hours or mileage demand as opposed to a flat rate based on a general average. Discussion is invited upon this question in order that intelligent action may be taken thereon.

In conclusion the secretary would urge the active support of all members in sending in items of new sales and shipments to be published in this department. Mr. Fred T. Kitt of Sacramento writes that he has sold a car load of Columbus pleasure vehicles and has two more car loads on the way. The Sacramento Electric Gas and Railway Company have bought a Columbus runabout for the use of their office and another purchaser has bought a 1200-pound Waverly delivery wagon. Other members have possibly done as well and should not be backward in letting it be known. Interesting articles have been received from a number of electric vehicle men and will be published monthly in this department, which will be enlarged in accordance with the amount of material received from members.

TREAT BATTERY AS YOU TREAT A HORSE.

The same thought and attention that every intelligent man bestows on a horse should be applied to the battery in his electric vehicle, and the same degree of intelligence required for the care of a valuable horse is sufficient for proper management of a battery. The rules to be followed are expressed in different words, but it is curious how closely they parallel the rules that apply to a horse.

Charging a battery, for instance, is much like feeding a horse. It should be done regularly, at the proper time and within proper limits. If one were driving a horse on short trips about town he would not feed him at every hitching post. Neither should he put his battery on charge every time he houses it in the garage. One should wait until the battery has been discharged down to a certain point, and then give it a full charge. A full charge, however, does not mean overcharging any more than a good feed means overfeeding. Overfeeding a horse may produce fever and just so overcharging will raise the temperature of the plates unduly and injure them.

On the other hand, no one would work a horse until it had used up the last item of strength in its body, and so you should not use a battery until every volt of current has been discharged. The rule is not to discharge a battery below 1.70 volts per cell—or for a 30 cell battery 51 volts. That is just the way you should treat a horse. Again, if your horse has been worked to pretty near the limit of its strength you do not allow it to stand long in the barn without a feed. Just so with a battery. It should be kept charged, whether you are going to use it or not. The battery should always have a sufficient supply of water. This is just as true of a horse, though for a different reason; but water is quite as essential to the battery as it is to the horse and the strength and vitality of one cannot be maintained any more than the other without water. The analogy might be pushed too far, but it is a general truth that if a man will give the same intelligent consideration to the needs of his storage battery as to those of a "hay motor" the care of an electric vehicle will prove far easier to him than that of any horse and the satisfaction of its use far greater.—Seattle Post-Intelligencer.

Electric vehicles in London are allowed in Hyde Park during certain hours in July, August and September. Other automobiles are prohibited. About 450 licenses have been issued for electric vehicles in London.

The electric vehicle at the National Electric Light Association Convention at Atlantic City, in June, will be a prominent factor. In addition to exhibits of the latest types of machines there will be shown storage batteries and other pertinent equipment.

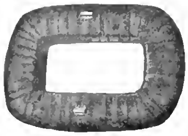
A transportation exhibition to be known as the International Exhibition of Railways and Land Transport is to be held at Buenos Ayres, Argentine Republic, from May to November, 1910. This is in connection with the forthcoming celebration of the hundredth anniversary of the independence of the Argentine Republic.

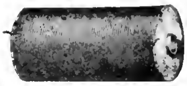
INDUSTRIAL

DELTABESTON MAGNET WIRE.

Since Deltabeston magnet wire was first placed upon the market, every effort has has been made to improve its excellent qualities. Only the purest fibre is used in the insulation and this is so treated that it is indestructible, so far as any temperature rise to which it may be subjected in actual service, is concerned. In addition to being heat-proof, Deltabeston wire is also made water-proof by thoroughly impregnating the insulation with a compound which prevents the absorption of moisture.

Deltabeston wire is today a necessary element in all service where extreme overloads play an important part and is especially suitable for the use in the manufacture and repair of railway motors, crane motors, air pump motors,





mill motors, lifting magnets, controller blow out magnets and arc lamps. Recently tests have been made to compare the properties of this wire with those required and covered by the U. S. government specifications. The specification reads in part as follows:

"When subject to a temperature of 160 degrees C., neither the asbestos covering nor the water-proof compound shall be injuriously affected. Six-inch samples of wire, with carefully paraffined ends shall be immersed in fresh water at a temperature of 22 degrees C. for a period of 24 hours. The per cent of water absorbed by the insulation during such immersion shall not exceed 4 per cent."

As the result of these tests Deltabeston magnet wire more than fulfilled the requirements and the contract was awarded to the D. & W. Fuse Company.

TRADE CATALOGUES.

"Quality Telephone Cords" is an illustrated bulletin (No. 47) issued by the Kellogg Switchboard & Supply Co., Chicago, Ill., and San Francisco, Cal.

"San Francisco and Roundabout" is a collection of beautiful scenes in the region indicated. It has been copyrighted by the San Francisco Sight-Seeing Company and may be obtained from the railroad companies.

"Landis Fans for the Electrical Contractor" is the title of a neat booklet from the Standard Electrical Works, San Francisco. A short description of various types of direct and alternating current fans is supplemented by detailed directions for installation.

Circular No. 1502 from the Westinghouse Electric & Manufacturing Company, illustrates and describes Westinghouse distributing transformers, potential regulators, lightning arresters and insulators. It contains information of value regarding the installation of transformers, the use of underground systems of distribution and other data of interest to central station men.

A bulletin on rural line construction (No. 45) issued by the Kellogg Switchboard & Supply Co., Chicago, Ill., and San Francisco, Cal., will prove of interest at this time to telephone men. It is carefully illustrated, showing the best practice in setting poles, guying, bracing and wiring. Explaining the different wind and other strains, and the importance of careful guying, gives transposition brackets, insulators, arms, arm braces, etc. Tools required in line and telephone work and costs. Also the forms and contracts, constitution, by-laws and rules of order generally used by farm companies.

A NEW ARC LAMP FOR TWENTY-FIVE CYCLE CIRCUITS.

The pulsations of a 25-cycle enclosed carbon arc are visible to the eye. Light emanating from such a source cannot be considered satisfactory for many classes of artificial illumination, and will not ordinarily be used in any case where a more suitable circuit is available.

With the more extensive use of lower frequency alternating current for railroad and stationary motor power, there are parks, railroad terminals, factory buildings, and factory yards to be lighted. For such general illumination the 25-cycle enclosed arc is being used and considered satisfactory. Heretofore, the only enclosed arc lamp available has been a modification of some lamp designed for higher frequency circuits, such modifications consisting of the use of extra or

Fig. 1.

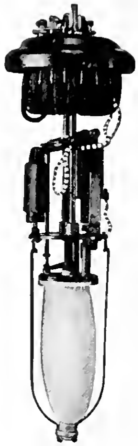


Fig. 2.

more flexible springs to take up the extreme vibration of the mechanism. A construction embodying the use of very light springs is decidedly questionable as such springs must stand the strain caused by the inrush of starting current.

Figure 1 shows the external appearance, and Figure 2 the mechanism of a lamp designed by the General Electric Company to meet these exacting requirements.

The frame is of the well-known two rod type. The mechanism consists of a rocker frame carrying the lamp magnet and suitable current adjusting counterweight. The armature is of standard laminated construction, but is stationary and held rigidly to the lamp base casting. By the use of this considerable weight in the moving element, and by making the armature a part (mechanically) of the lamp frame, all objectionable vibration is absorbed or deadened, thereby permitting the elimination of all springs. The lamp is as quiet and free from vibration in starting and operating as standard lamps for higher frequencies.

Where this lamp is to be operated on 220 or 440 volt circuits an external as well as internal compensator must be used (fig. 1) and a third binding post placed on the lamp top, while for nominal 110 volt circuits the lamp is self-contained.

NEWS NOTES

FINANCIAL.

COALINGA, CAL.—The Judges Oil & Mining Company has levied an assessment of five cents per share on the capital stock of the company.

SAN FRANCISCO, CAL.—The San Lucia Oil Company has levied an assessment of 44 cents per 100 shares on the capital stock of the company.

SAN FRANCISCO, CAL.—District Judge Van Fleet has issued an order in the United States Circuit Court for the sale of the properties of the Tuolumne Water Power Company and the Stanislaus Electric Power Company on May 10, 1909, at the court house building, Sonora, Tuolumne county, to satisfy the mortgage of the Knickerbocker Trust Company, New York.

SAN FRANCISCO, CAL.—The Clear Lake Northern Railroad Company has mortgaged all its real property and easements to the Mercantile Trust Company of this city, for $1,000,000, to guarantee a bond issue of that sum to be used in improvements and construction. The proposed road will run from Pieta, Mendocino county, to Lakeport, Lake county, a distance of 31 miles.

OAKLAND, CAL.—The Security Bank & Trust Company, the Oakland Bank of Savings, the First National Bank and the Central Bank, have arranged to take complete control of the People's Water Company of this city. These four banks will advance the money needed to pay off the water company's floating debt and to make the improvements and extensions which have been badly needed since the earthquake.

SAN FRANCISCO, CAL.—The following estimates of value of the Spring Valley Water Co.'s plant have been made: President Bourn's figure, $40,000,000; city's valuation, $24,000,000; F. L. Sterns, $70,000,000; James D. Schuyler $45,960,000; Herman Schussler, $51,500,000; Rudolph Hering, $44,770,900; Arthur L. Adams, $40,000,000; C. E. Grunsky, $24,673,212; J. H. Dockweiler, $24,053,390; Desmond Fitzgerald, $22,736,643; price at which company offered to sell, $32,000,000; par value of company's securities, $32,000,000; market value based on recent sales, $25,000,000. Thus, a difference of $16,000,000 remains to be settled between the city and the company before a bargain can be made.

INCORPORATIONS.

RIVERSIDE, CAL.—The Union Water Company has been incorporated here with a capital stock of $25,000 by C. M. Burket, E. C. Kennedy, J. Mill and E. E. Peek.

SAN BERNARDINO, CAL.—The San Gabriel Valley Home Telephone Company has been incorporated here with a capital stock of $2,000 by H. F. Metcalf, H. V. Carter, E. O. Fawcett, E. E. Bailey and W. M. Northrup.

SAN FRANCISCO, CAL.—The San Benito Light & Power Company has been incorporated here with a capital stock of $250,000 by Charles W. Waller, Percy M. Reeves, Thomas P. Pheby Jr., H. P. Pitts and H. M. Wright.

SAN FRANCISCO, CAL.—The Smith River Electric Company has been incorporated here with a capital stock of $250,000 by D. C. Demarest, E. C. Hegler, S. Harris, C. M. Lindsay, W. P. Swart, A. V. Massy and Carl Senn.

RIVERSIDE, CAL.—The Corona Union Telephone & Telegraph Company has been incorporated here with a capital stock of $25,000 by J. G. Jamesson, E. J. Generaux, C. M. Scottville, G. E. Snidecor, W. L. Prizer, W. L. Peelerf and D. Lord.

RENO, NEV.—The Lander County Power & Light Company has been incorporated here with a capital stock of $200,000. The company proposes to construct electric power, telephone and telegraph lines in the state of Nevada.

FRESNO, CAL.—The Sierra Park Company has been incorporated here with a capital stock of $100,000 by C. K. Kirby, John W. McLaughlin, C. K. Kirby, Jr., F. K. Kirby and D. C. McLaughlin. A power plant will be built near the headwaters of the San Joaquin river.

OAKLAND, CAL.—The Central Oakland Light & Power Company has been incorporated here with a capital stock of $1,250,000 by A. M. Hunt, James Fisher, J. K. Moffitt, M. S. Wilson, M. D. Levenson, F. G. Cartwright and C. N. Beal. A site has been purchased for its plant on Alice street, between First and Second.

PETALUMA, CAL.—The San Antonio Telephone Association has been organized here with James Sorensen as president and Nels Mastrup as secretary. Other directors are: G. B. Lavaroni, M. Fillippini and W. Leper. A rural telephone line will be constructed between Petaluma and the San Antonio country.

SAN FRANCISCO, CAL.—The Sacramento Valley Power Company has been incorporated here with a capital stock of $800,000 by P. C. Morf, H. C. McPike, L. Q. Haven, J. J. Dailey, J. F. McCue, F. W. Nightingill and E. A. Potter. Work on the construction of reservoirs and other adjuncts of a power system will begin this summer.

SAN FRANCISCO, CAL.—The Equitable Light & Power Company has been incorporated here with a capital stock of $750,000. The company proposes to supply electricity, hot water and steam to consumers. Plants are about completed in the Phelan and Whitney Buildings. Another plant is to be built outside the city. The incorporators are F. G. Cartwright, A. E. Long, L. G. Meyberg, M. S. Wilson, M. D. Levenson, C. N. Beal and Jas. Fisher.

TRANSMISSION.

OXNARD, CAL.—The Ventura County Power Company is to construct an electric power line to the Converse ranch on the Santa Clara river.

CHICO, CAL.—The Sierra Electric Power Company has been granted a franchise to erect an electric power distributing system in this city.

SANTA BARBARA, CAL.—Bids will be received up to May 6, 1909, by the city council for a franchise to erect an electric power distributing system in this city.

SANTA BARBARA, CAL.—The Pacific Improvement Company has been granted a franchise to construct an electric light and power line between this city and the Hope Ranch.

FRESNO, CAL.—The San Joaquin Light & Power Company has asked for a franchise to erect an electric power line through the Academy country to Sanger, a distance of 19 miles.

PARKER, ARIZ.—T. M. Drennan, J. L. Curtis, Fred T. Bragonier, C. F. Shades and Le Roy Anderson have been granted a franchise to construct an electric power plant and water works in this city.

RED BLUFF, CAL.—The Siskiyou Electric Power & Light Company will begin work on its new plant this spring. Jessie H. Churchill has been chosen president. The management proposes to install machinery capable of developing 60,000 horse-power.

ILLUMINATION.

PORTLAND, ORE.—New bids will be received for lighting the streets on three and five-year contracts.—City Auditor Barbur.

FORT BRAGG, CAL.—The Fort Bragg Electric Company will enlarge its plant by installing a 750 kilowatt dynamo and a steam turbine engine this summer.

CHICO, CAL.—Manager E. W. Florence of the Pacific Gas & Electric Company announces that henceforth the minimum rate on electric meters will be $1 per month instead of $2.

SAN LUIS OBISPO, CAL.—President W. F. Broadman of the San Luis Gas & Electric Company visited this city last week and announced a number of improvements to the company's plant. Over four miles of new gas mains are to be constructed this spring.

TRANSPORTATION.

SAN RAFAEL, CAL.—S. A. Moss has applied for a franchise to construct an electric line between Manzanita station and a point above Coyote Creek.

MODESTO, CAL.—The Modesto Interurban Railroad Company has let contracts for the construction of five miles of roadbed to connect the Modesto line with the Santa Fe. Active work will commence next week.

RENO, NEV.—The following directors have been chosen to manage the Nevada Interurban Railroad Company for the next year: Louis Berrum, Charles Sadlier, George Perkins, Fred Grob, John Evans and Sam Rosenthal. Louis Berrum was chosen president and Sam Rosenthal secretary.

SACRAMENTO, CAL.—George W. Peltier, of the Central California Traction Company announces that the company will establish a car factory just outside of this city near the State Agricultural Society's grounds. In addition to the manufacture of cars repair shops will be installed for repairing the company's rolling stock.

SAN FRANCISCO, CAL.—Health Officer R. G. Brodrick, Superintendent E. D. Gibbs, and Special Investigation Officer W. E. Rice have reported on the cleanliness of the cars and car barns of the United Railroads Company. Sixty-five men are employed to wash the 580 cars which the company operates daily on its lines. The car barns are stated to be kept in good condition.

NEVADA CITY, CAL.—L. W. Storror, the Pacific Coast representative of the Postal Telegraph & Cable Company, recently visited this city for the purpose of interviewing Supervisor Bigelow, relative to securing rights-of-way through the Tahoe National Forest for a telegraph line. The company proposes constructing a line from Sacramento to Salt Lake City and other Eastern points.

OAKLAND, CAL.—The Oakland Traction Company began operating last week 20 new cars on its suburban line between Oakland and Haywards. These cars, which are products of the company's shops at Emeryville, are considered to be equal to any of the street railway roiling stock about the bay. A new timetable is to be installed this week and the terminus of the line is to be Twelfth and Broadway.

FRESNO, CAL.—At a directors' meeting of the Fresno, Hanford & Summit Lake Railway Company, two directors, O. L. Everts and A. L. Jones, were chosen to succeed W. A. Sage and R. L. Pfell. It was decided to change the principal place of business from Hanford to Fresno. Vice President W. E. Davis of the Cleveland Construction Company, which is to build and operate the new road, has been detained in the East and is not expected to arrive in this city before April 15th.

WATER.

SAN RAFAEL, CAL.—The Marin Water Company has been awarded a contract to lay pipe lines through Deer Park.

SAUSALITO, CAL.—Bids have been received for the necessary equipment for the $100,000 water system to be installed here.

IMPERIAL, CAL.—Plans are now under way for the construction of a municipal waterworks, which it is estimated will cost $50,000.

PLACERVILLE, CAL.—H. C. Marsh has filed a notice of appropriation of 15,000 inches of the water flowing in the South Fork of the American river.

WHEATLAND, CAL.—The Board of Trustees have awarded the Abner Doble Company a contract for supplying a 500-gallon pump and a 50 horse-power motor, costing $2,000, to be used at the municipal water works.

SANTA ANA, CAL.—The City Council has accepted the bid of the Pacific Coast Manufacturing Company for furnishing a Murry-Corliss engine, costing $10,350, at the municipal water plant.

SAN BERNARDINO, CAL.—The Pacific Coast Supply Company has been awarded a contract to furnish 9,000 feet of wrought iron pipe as per their bid, for 4-inch pipe at $31.80; 3-inch pipe, $21.88; and 1-inch pipe, $10.13.

BAKERSFIELD, CAL.—The Kern-Midway Water Company has purchased a 30 horsepower motor which is to be installed to the present water plant. The rates, which have been reduced one-third, will take effect this month.

SAN FRANCISCO, CAL.—Two of the highest officials of the Spring Valley Water Company resigned this week, J. C. Booker, chief of the departments of accounts, inspectors and collections, and J. M. Duke, the secretary of the company.

SAN FRANCISCO, CAL.—The Board of Public Works has let the contract for supplying the pipe for the auxiliary fire system to the United States Cast Iron Pipe & Foundry Co. Under the terms of the contract the city will pay $920,988.56 exclusive of the freight charges.

CHICO, CAL.—An underground water system to take the place of the present ditch system is being installed at the National Plant Introduction Gardens, near this city. Ten-inch mains nearly a mile long will cross the farm at short distances and these will supply distributing pipes to hydrants 200 feet apart.

YUBA CITY, CAL.—Contracts for furnishing the aparatus for the municipal water plant to be installed here were let to the Doak Gas Engine Company for $5,600. Other bidders were the Hampton Hardware Company of Marysville, the United Iron Works of San Francisco, the Sansom Iron Works of Stockton, Fairbanks-Morse Company of Stockton, and the Nevada Machinery Company of San Francisco.

OIL.

SAN FRANCISCO, CAL.—The Associated Oil Company has been directing its attention to the district about Coalinga and has practically ceased developing at Kern River.

SAN FRANCISCO, CAL.—J. M. Danziger and B. B. Lathbury have purchased 30 acres of the Emerald Oil Company on the west edge of the Kern river, with six producing wells.

LOS ANGELES, CAL.—According to authorities the California Oil producers are facing a crisis. A large drop in prices is looked for and steps are being taken to curtail the output until the consumption catches up. The output is now 10,000 barrels a day in excess of consumption, and growing so disproportionately that by the end of the year it would be 22,000 at the present ratio.

TRADE MARKS

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Kierulff, B. F., Jr. & Co., "Sterling."
Sterling Elec. Co.
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Johns-Manville Co., H. W.

INDEX TO ADVERTISEMENTS

AUTOMOBILE ACCESSORIES

American Eveready Co., "Ever Ready."

BATTERIES

DRY BATTERIES

American Eveready Co., "Ever Ready" and "Crescent."
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Standard Electrical Works, "Standard."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

DRY BATTERY HOLDERS

Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES

Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY

Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

STORAGE BATTERIES

Elec. Storage Battery Co.
Westghse Machine Co.

BELLS

ELECTRIC BELLS

Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
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Partrick, Carter & Wilkins Co.
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Western Electric Co., "Hawthorne."

ELECTRO-MECHANICAL GONGS

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MAGNETO BELLS

Dean Elec. Co.
Elec. Appliance Co., "Eaco."
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Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

BOILERS

Henshaw-Bulkley & Co.
Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, "Edge Moor."

BOOKS

Technical Book Shop.

BOXES

WALL BOXES

Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knock-out."
Chicago Fuse Wire & Mfg. Co., "Union."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
General Electric Co.
Paiste, H. T. Co.
Pass & Seymour.
Sprague Electric Co., "Universal."
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Stanley & Patterson, Inc., "Simplex"

BRACKETS

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Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS
Cutter Co., The, "I-T-E," "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
Kierulff, Jr., & Co., B. F. "Hartman."
Pacific Electric & Manufacturing Co.
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLAMPS
GROUND CLAMPS
Belden Manufacturing Co.
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Chase-Shawmut Co., "Shawmut."
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FIBRE CLEATS
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General Electric Co.
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Standard Electrical Works, "Standard."
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COILS
ARMATURE AND FIELD COILS
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Electric Goods Mfg. Co.
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Dearborn Drug & Chemical Works.
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Belden Mfg. Co.
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Bryant Electric Co.
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Electric Appliance Co., "Colonial."
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FLAMING ARC LAMPS

General Electric Co., "G. I."
Western Elec. Co., "Victor."
Westghse Elec. & Mfg. Co.

GAS ARC LAMPS

Welsbach Company.

INCANDESCENT LAMPS

Brooks-Follis Elec. Corp., "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co., "California."
Columbia Inc. Lamp Co., "Columbia."
Elec. Appliance Co., "Packard."
General Elec. Co., "Edison," "Lowatt."
Johns-Manville Co., H. W., "Linolite."
Kierulff, B. F., Jr. & Co., "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc., Lamp Co., "Sunbeam," "Regal."
Western Electric Co., "Sunbeam," "Regal."
Westghse. Elec. & Mfg. Co., "Westinghouse."

MINIATURE LAMPS

American Eveready Co. "Ever Ready."

TANTALUM LAMPS

Bryan-Marsh Co., "Imperial."
Columbia Inc. Lamp Co., "Columbia."
General Elec. Co., "Meridian Tantalum."

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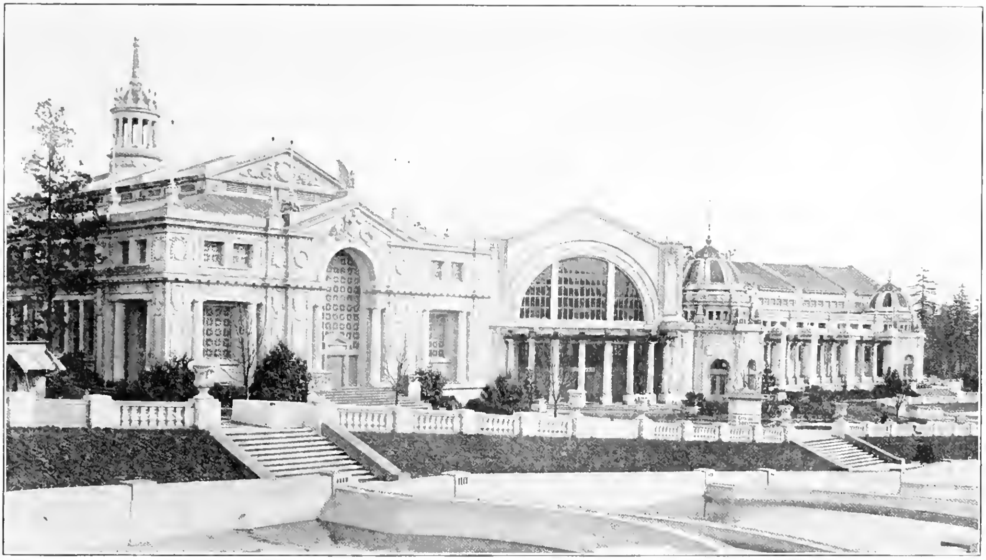
ELECTRICITY AT THE EXPOSITION

BY J. S. HARISBERGER



Portion of Grand Canal Showing Oriental Building and Manufacturers' Building, Alaska-Yukon-Pacific Exposition, with Cascades in Foreground.

THE Alaska-Yukon-Pacific Exposition to be held at Seattle from June 1st to October 16th, 1909, is representative of the natural and developed resources of the Alaskan and Yukon Territories and the Pacific Northwest.

It is said to have the most beautiful natural site of any exposition ever held. It will occupy about two hundred and fifty acres of the campus of the University of Washington, bordering on Lake Washington and Lake Union, two natural bodies of fresh water, having areas of thirty-eight and one-half square miles, and one and one-third square miles, respectively.

Looking over Lake Washington to the south, Mt. Rainier, is seen in its grandeur. Mt. Baker, another magnificent peak, is plainly visible from the grounds. To the northeast are the Selkirk Mountains, and to the west are the snow-covered crests of the Olympics.

The landscape artist has not allowed man to disturb nature any more than necessary. As far as possible the trees and shrubs have been left standing, resulting in many natural park effects.

In the development which characterizes a modern exposition, the supply of electricity for illuminating and power purposes becomes an important consideration. Seattle is particularly blessed in having an abundance of water power, a comparatively short distance from her doors. Her proximity to snow covered mountains enables her to take advantage of the result of Nature's ideal method of storing power.

Some of this power obtained from the glaciers of Mt. Rainier, in the Cascade Range, has been developed by the Puget Sound Power Company. This company furnishes power to the Seattle Electric Company, who have been granted the exclusive right to furnish all electric current used on the grounds. They also furnish all power for electric cars carrying passengers to and from the Exposition.

The hydro-electric plant is located at Electron, fifty miles away, from where power is transmitted to Seattle at 55,000 volts, 3 phase, 60 cycles. At the main Seattle substation this current is transformed down to 13,800 volts, 3 phase, at which pressure it is transmitted to the substation at the Fair grounds, a distance of about five miles.

The substation, or service plant, is located on the west border of the Fair grounds, about half way between Lake Union and the northern boundary. It is a wooden frame structure of pleasing design. The plant has been laid out on the simplest lines possible to reduce complication and to insure reliability and ease of operation. Standard apparatus has been employed as far as possible, and of such size units as can be used elsewhere after the fair.

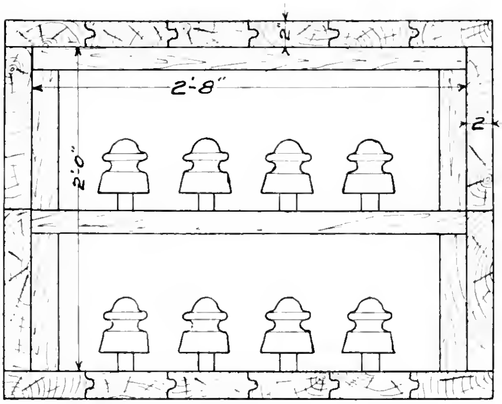


Fig. 1. Underground Conduit, A. Y. P. Exposition.

In this plant are four 1,000 k.w. G. E. air blast transformers connected in two banks 3 phase-2 phase, 13,800 primary, 3 phase side and 2,300 volt secondary, 2 phase side. These transformers are kept cool by two Buffalo Forge Company's blowers, direct connected to two G. E. 4 h. p., 220 volt 2 phase induction motors, 720 r. p. m.

In this station are also two G. E. synchronous motor generator sets for furnishing D. C. power to the street railway in the vicinity of the Exposition; these sets may be started from either A. C. or D. C. side. Each of these sets consists of one rotary field 1,400 h. p., 13,800 volts 3 phase synchronous motor 514 r. p. m., one 1,000 k.w., D. C. class 10,000 volt generator having commutating poles, exciter being mounted on same shaft. These sets are controlled from switchboards of standard design. The 13,800 volt switches are of the oil type, electrically operated, remote control, with overload release.

On switchboards are also mounted two Tirrell regulators for varying the power factor so as to maintain good voltage regulation on the A. C. feeders. All wiring in station is rubber insulated with flame proof covering. Circuits of 2,300 volts and over are controlled by oil switches with overload release. From this station all feeders leave overhead and are strung around the edge of the grounds on a pole line, from which connections are made at eight different points to circuits in underground wooden ducts, as shown in Fig. 1. These ducts are buried to a depth of about three feet and carry the 2,300 volt circuits to the transformer vaults installed in the larger buildings. There are four single phase 2,300 volt feeders for twenty-four hour service; three two phase 2,300 volt feeders for decorative lighting, and one two phase 2,300 volt power feeder; to this feeder are connected all services for power purposes including three 200 h. p. Westinghouse induction motors direct connected to four stage Worthington pumps to be used for pumping water from Lake Washington for fire protection, etc.


Fig. 2. Electroliers.

On feeders for the twenty-four hour service are the usual indicating meters as well as Bristol recording volt meters, and in each circuit is an induction regulator.

The current supplied to feeders for decorative lighting is controlled by a water rheostat which brings the lights gradually up to candle power, an arrangement similar to that used at the Pan-American Exposition.

The transformer vaults are located next to the outside walls of the buildings with direct outside access, and are so constructed that they are practically fireproof, having ample ventilation to carry off all heat from the transformers. The walls and ceilings of the vaults are built of two thicknesses of two-inch plank laid in opposite directions, with an interlining of asbestos board laid between the two thicknesses

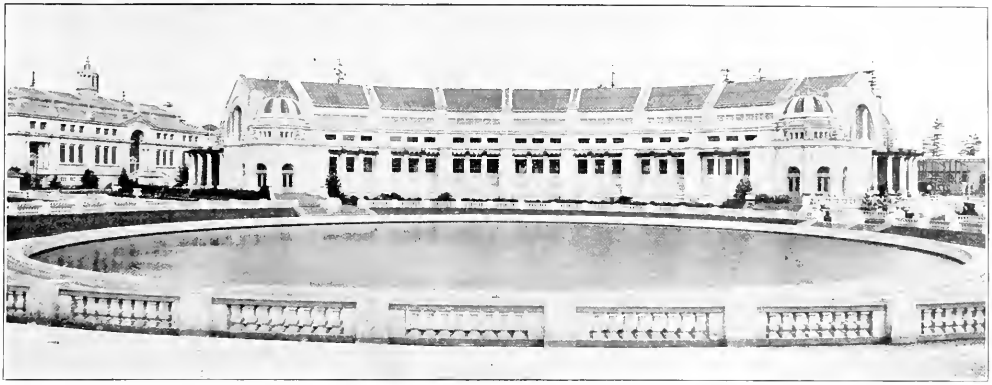
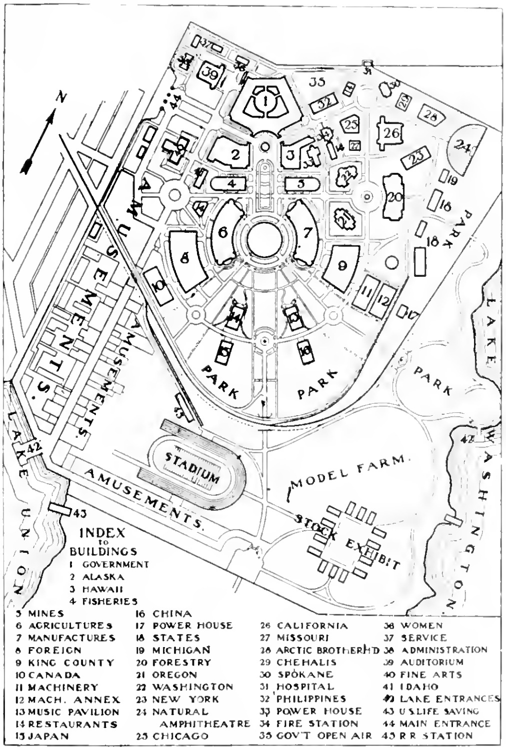


Fig. 3. Looking Across Geyser Basin Toward Manufacturers' Building.

of plank. The inside of all vaults is lined with galvanized iron.

In these vaults are installed oil insulated, self cooled transformers for stepping down the current from 2,300 volts to 117-234 volts for three wire distribution.



Ground Plan of the Exposition.

In the Government Building is installed a 100 k. w. motor-generator set for furnishing 230 volt direct current for three wire distribution, this being necessary for the Government exhibits; with this exception, all current on the grounds is alternating.

Wiring in the permanent buildings that will revert to the University of Washington after the Fair, is first class conduit work. In all other buildings wiring is exposed, using flame proof wire.

Incandescent lamps are used throughout, excepting a few other types which may be used for exhibition purposes. For decorative lighting, frosted eight candle power lamps will be used entirely, placed eighteen inches apart on outside of buildings in such a way that indirect illumination will be effected, bringing out the outlines of the buildings and such parts of the buildings that architectural features may suggest.

For the art gallery 100 watt tungsten lamps with shovel reflectors will be employed. Around the grounds will be used about two hundred and fifty electroliers as shown in Fig. 2. This design was specially gotten up for the Exposition. The globe on it contains thirty-nine 20 candle power frosted lamps.

The Geyser Basin, Fig. 3, is one of the features of the Exposition. The bottom is studded with incandescent lamps which give a very pretty effect at night.

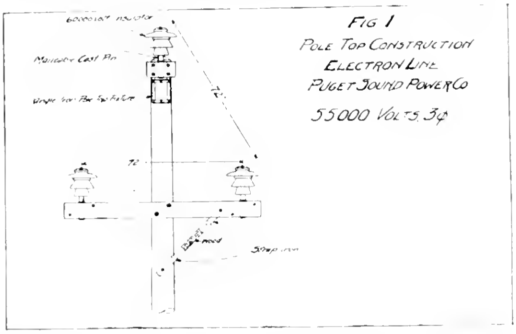
The Cascades is a series of six waterfalls over which tumble ten thousand gallons of water per minute. Behind each fall is a line of light which gives a beautiful rainbow effect through the water. The water supplying the Cascades is circulated by two Krogh pumps, one belted to a 50 h. p., and the other to 100 h. p. Allis-Chalmers induction motor. These pumps are installed in the Agricultural Building.

Cactus sap as a rubber substitute has been the subject of successful experiments by a forest officer in India. The cactus or plant from which the sap was taken for these experiments is described in Watt's Dictionary of Economic Products of India as a "large, fleshy shrub common on rocky sides of the outer Himalayas from Koumourin, and at an altitude of 6,000 feet. The milky sap of this plant contains a large amount of gutta-percha." Should the sap of the American cacti prove available for the purpose described, it would open up a new and valuable industry. The U. S. Consul General at Calcutta will be glad to connect anyone with the Indian officer in question.

NOTES ON TRANSMISSION PRACTICE IN THE NORTHWEST[1]

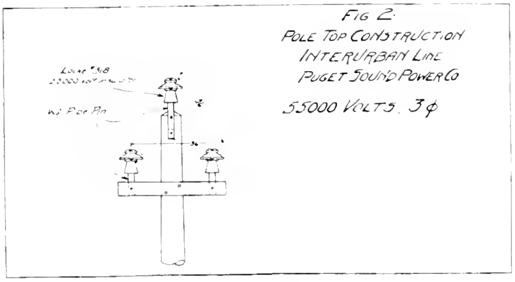
BY MANGUS T. CRAWFORD.

The object of this paper is to assemble in a form convenient for comparison and discussion the various systems of high tension transmission in the Northwest, and to discuss the relative merits and defects of each system. As each section of the country has its own characteristic set of climatic and industrial conditions, transmission practice features that are economical and good practice in one section may be more or less unsuitable in another section. For this reason this discussion will be confined to practice in the Pacific Northwest. As typical examples, a number

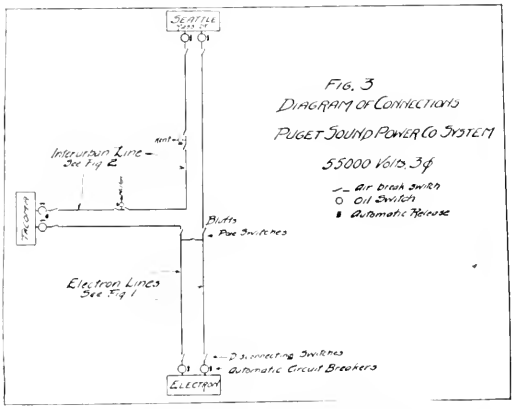


of systems will first be briefly described, and discussed in detail later.

Puget Sound Power Company. This company operates a hydroelectric station at Electron, Washington, on the Puyallup River. Two 55,000 volt, three phase lines run parallel to Bluffs, where they separate; one goes to Tacoma, the other to Seattle, following the Puget Sound electric railway right of way. These lines were built in 1903 and have the construction shown in Fig. 1. The wire is 0000 B. & S. 19-strand

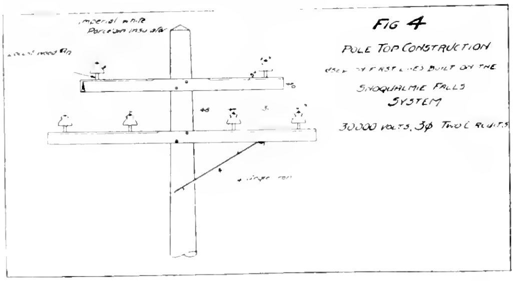


semi-hard-drawn copper, except from Bluffs to Tacoma, where it is 0 B. & S. solid copper. The insulators are standard four-piece, 60,000 volt porcelain on galvanized malleable cast iron pins of a design similar to a pipe pin. Part of this line was equipped with wooden pins for trial, but the iron pins have proved more satisfactory. The length of the Seattle line is about fifty miles, that of the Tacoma line about thirty miles. At the generating and substation each line is controlled by a switchboard panel equipped with three ammeters, one automatic, remote control, oil circuit breaker, and one overload time limit relay. The circuit breakers are electrically operated oil switches in concrete compartments. At Bluffs, disconnecting pole switches are used for paralleling and cross connecting the lines, as shown in Fig. 3. A second line of solid copper, known as the interurban line runs parallel and on the opposite side of the railway, feeding into substations located at Massachusetts street, Seattle, and at Kent, Milton, and Tacoma. The size of the wire is 1 B. & S. solid copper from Seattle to Georgetown,



4 B. & S. from Georgetown to Milton, and 1 B. & S. from Milton to Tacoma. This line is constructed as shown in Fig. 2, and has been operated at 55,000 volts for the last few months. It was originally built for this voltage, but until recently has been operated at 30,000 volts. Although the spacing between wires is rather small, no trouble has been encountered, as the spans are not over one hundred feet.

This company reports practically no trouble from electrical failures of insulators on either line, as all



insulators were tested before they were accepted. The only trouble has been from softening and burning of wooden pins. These pins have been replaced by wrought iron pipe pins, and no difficulty has arisen since.

Seattle-Tacoma Power Company, Snoqualmie Falls System. The system of this company has been in operation for ten years, and is the oldest high tension transmission system on Puget Sound. Some of the apparatus installed is of a type now obsolete, but the plant is being gradually rebuilt, and much of it is new

[1]Paper read before Seattle Section of the American Institute of Electrical Engineers, December 19, 190[illegible]

and modern. The main generating station is at Snoqualmie Falls. As originally built, this system consisted of a double pole line from Snoqualmie Falls to Renton, and single pole lines from Renton to Tacoma and from Renton to Seattle. Each pole line carried two three-phase, three wire, 30,000 volt circuits arranged as shown in Fig. 4, with a space of thirty inches between the wires. The wires were of alluminum with a cross section of approximately 65,000 cir. mils. The insulators were triple petticoat imperial porcelain of the Redlands type. After a few years' operation, this system was rebuilt with larger wires and a larger space between them. Various difficulties were encountered with the thirty-inch spacing—large

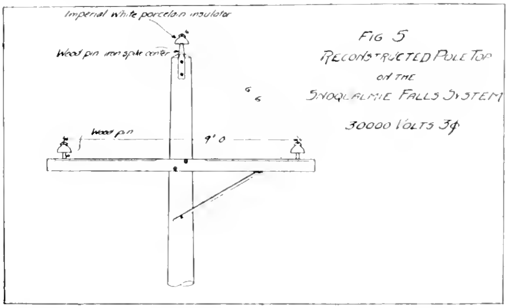


FIG 5
RECONSTRUCTED POLE TOP
OF THE
SNOQUALMIE FALLS SYSTEM
30000 VOLTS 3φ

birds, sticks, bale wire, etc., became entangled in the wires, causing short circuits. A wire once burned off was apt to whip around and short circuit the others as well.

In 1903, the lines were reconstructed with only one circuit per pole line, giving a nine-foot by six and one-half foot flat triangular spacing as shown in Fig. 5, by simply removing the top cross arm and putting on a pole top pin. A new pole line was built from Renton to Tacoma, and one from Renton to Seattle,

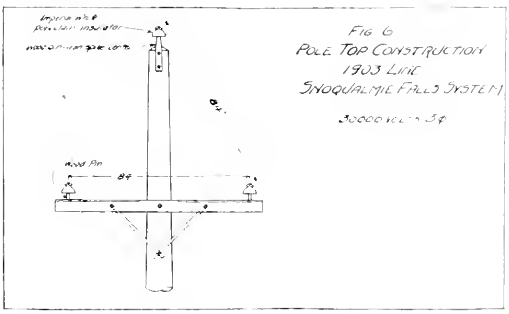


FIG 6
POLE TOP CONSTRUCTION
1903 LINE
SNOQUALMIE FALLS SYSTEM
30000 VOLTS 3φ

with a seven-foot triangular spacing as shown in Fig. 6. The same insulators were used, as they had proved satisfactory. This gave two separate pole lines from Renton to both Seattle and Tacoma. On these lines a seven-strand aluminum cable of OO B. & S. gauge was used, and from Renton to the falls each line was of seven-strand aluminum OOOO B. & S. gauge. The reconstructed system has now been in operation about five years, and the wide spacing has given almost entire freedom from trouble due to short circuits between the wires. As shown on the sketch, the insulator pins are of locust wood. About a year ago these pins began to give trouble from burning and softening. They were replaced on curves and important points by malleable cast iron pins.

In 1906, this company built a single pole line from Snoqualmie Falls to Everett, with the construction shown in Fig. 7. The line was of No. 4 medium hard drawn copper, and the insulator of shape similar to the imperial white insulator on the main lines, but made of brown porcelain. Malleable iron pins were used throughout, being fastened to a channel at the pole top as shown. The porcelain was not of so good a quality as that in the imperial white insulators, and occasional trouble resulted from insulators shooting through the

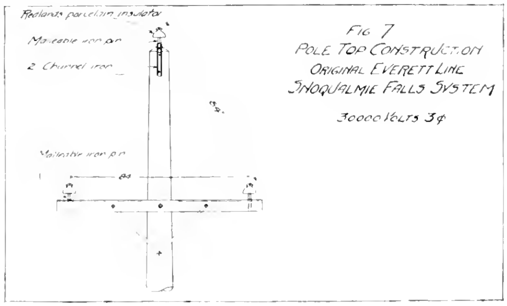


FIG 7
POLE TOP CONSTRUCTION
ORIGINAL EVERETT LINE
SNOQUALMIE FALLS SYSTEM
30000 VOLTS 3φ

head to the pin when a ground came on the system. In 1908, this line was reconstructed for 60,000 volts in order to carry the increased load, and as the first step in the change of the entire system to 60,000 volts. The new construction is shown in Fig. 8. There has been no trouble of any nature, though the line has been in service several months.

The general switching arrangement is shown in Fig. 9. There is no automatic release anywhere on main lines, as this company believes such apparatus

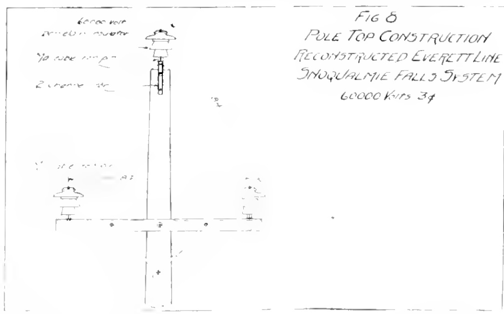


FIG 8
POLE TOP CONSTRUCTION
RECONSTRUCTED EVERETT LINE
SNOQUALMIE FALLS SYSTEM
60000 VOLTS 3φ

to be a hindrance rather than a help. This will be discussed more fully later. The switches used at the falls are non-automatic oil switches in compartments. Those at Renton, Seattle, and Tacoma are tank switches, consisting of a double break switch immersed in a separate tank of oil for each leg of the line. They are controlled manually by an arrangement of levers. This company has never had any trouble from high tension oil switches, although they have been used to open some severe short circuits. On outside lines, a disconnecting pole switch is used. For branch lines, a horn fuse is also used, either on a

pole or on a bracket fixture on the outside of the station wall. Small substations are equipped with an air break fuse inside the station.

Seattle Municipal Power Plant. At present, this system consists of one 30,000 volt transmission line connecting the generating station on Cedar River with the substation in Seattle. This line is of the same construction as that is Fig. 6, except that a three petticoat, two piece, 45,000 volt insulator is used. The pins are of eucalyptus wood boiled in oil; the wire is No. 2 solid copper with a seven-foot spacing. This line was built in 1904, and has given virtually no trouble from electrical failures of insulators or burning of pins. It is controlled by air break disconnecting switches on the high tension side, an automatic release being on the 2,000 volt side of the transformers at the generating station. A new line now nearing completion has a construction shown in Fig. 10. The line wire is 0000 B. & S. seven-strand copper, and the operating voltage is to be 60,000 volts. Spans are from 400 to 450 feet on the straight way. This is a radical departure from the present lines on Puget Sound, but represents the most recent practice in transmission. The old line is to be changed to

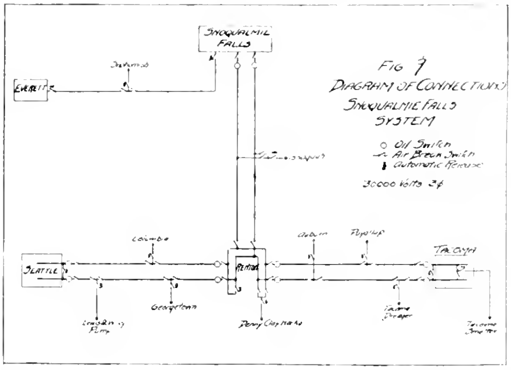


Fig 7
Diagram of Connections
Snoqualmie Falls
System

60,000 volts and the two lines will then be operated in multiple, with automatic oil switches on each line actuated by overload and reverse current relays.

Several months ago an attempt was made to operate the old line at 55,000 volts, the transformers being changed from delta to star connection. No difficulty was experienced in dry weather, but in wet weather so much trouble ensued that it was necessary to change back to the old voltage. The high voltage gave trouble by heavy leakage currents setting fire to the wooden pins. No trouble was experienced from electrical failure of the insulators during this time; there should have been no trouble, as the manufacturer's test on this type of insulator is 100,000 volts.

Whatcom County Railway and Light Company, Nooksack Falls System. This company has a hydroelectric generating station at Nooksack Falls, and supplies power to the city of Bellingham over a single transmission line. This line is built for 60,000 volts, but at present it is operated at 22,000 volts from delta connected transformers. The length of line is forty miles; the wire is 0 B. & S. seven-strand aluminum; the spans are about one hundred and fifty feet on the straight-away portion, while those at river crossings are as long as seven hundred and fifty feet. The pole top construction is shown in Fig. 1, except that a pipe pin is used, doing away with the pole top fixture. From the substation in Bellingham a branch line extends about two miles to Fairhaven, where there is a second substation supplying light and power to that section of the city. This branch line is connected to the main line by pole disconnecting switches. It is of the same construction as the main line with the exception of the spacing between wires, which is five feet, instead of six feet.

The only high tension switch used on this system is a simple knife disconnecting switch. All switching under load is done on the 2,000 volt side of the station transformers. Line short circuits open the automatic circuit breakers on the 2,000 volt side at the generating station, so that to obtain uninterrupted service it would be necessary to keep the steam generating station in Bellingham on the system at all times. This station is used only in emergency at present, as very little line trouble is experienced.

Having given some of the characteristic features of representative systems in this locality, a comparative discussion may now be of value. In this I shall draw freely on the experiences of the different companies, the opinions of their engineers, and also on

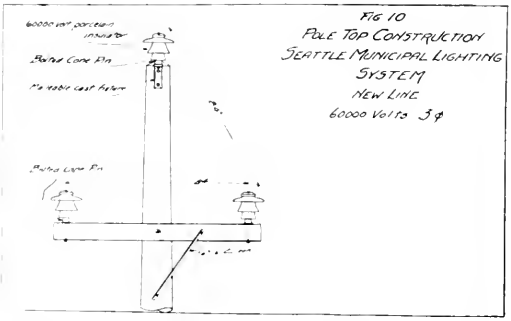


Fig 10
Pole Top Construction
Seattle Municipal Lighting
System
New Line
60000 Volts 3φ

the opinions of representative engineers of the present day as set forth in recent papers before the American Institute of Electrical Engineers.

One of the things for which Western practice is criticized is the tendency to build lines that are cheap. Mr. F. G. Baum has said in a paper before the Institute:

> It may not be as difficult to determine the proper power station and line to build when unlimited capital and ideal power conditions exist as when there is restricted capital, limited revenue, and low-priced power at the consumer's end.

Mr. Baum's idea is the answer to such criticism. In the Northwest especially, the lines are very long, passing through rough country; the cost of the transmission system is a big item in the total cost; the power business is usually more or less scattered; and revenue comparatively small. Economy must therefore be given consideration by the engineer or his designs will not be feasible, and his enterprise will not receive financial support. It requires much more thought and engineering ability to design a satisfactory line with limited expenditure than it does where the line forms a small part of the total investment and its first cost is comparatively unimportant.

In consideration of these facts, the item of first cost will be given attention in the following discussion.

Line Wire. Opinion seems divided between aluminum and copper for use in transmission and high voltages, but in general it may be said that both are satisfactory. As examples for comparison, take OOOO stranded aluminum and OO hard drawn solid copper. The stresses at elastic limit are taken at 15,000 and 20,000 pounds per square inch for copper and aluminum.

	0000 aluminum.	00 copper.
Resistance, ohms per 1000 ft.	0.079	0.0787
Elastic limit, pounds tension	2500	2090
Weight, pounds per 1000 ft.	195	103
Relative cost	90	100
Diameter over all, in inches	0.53	0.3648

There are many practical drawbacks to the use of aluminum: it is difficult to make good joints, as the metal will not take solder; it is a highly electropositive metal, and when exposed to the air in contact with other metals an electrolytic action is set up in which the moisture of the air and chemical impurities forms the electrolyte. These difficulties may be overcome by carefully made and protected joints. Aluminum has a very high coefficient of expansion with change of temperature, which is apt to be troublesome in climates having extremes of temperature. Its large diameter makes a larger surface for collection of sleet and ice and a larger resisting surface for high winds. In the Puget Sound country extreme temperatures, sleet, and very high winds are never encountered, so that aluminum is well adapted to local conditions. The systems using it have never had any difficulty which could be charged against the metal. As seen from the above figures, it is somewhat stronger, weighs about half as much, and costs ten per cent less for copper wires of the same conductivity. Ten per cent in the line wire is a fair size item in the line cost, and additional saving can be effected in freight and teaming in the delivery and stringing up in a rough country.

Poles and construction features. The question of poles versus towers is not considered in this part of the country, where excellent poles are obtainable on the ground and steel is expensive, although it may come in for consideration in later years. When the first lines were built in the Northwest, about ten years ago, the use of thirty-five-foot poles with seven-inch or eight-inch tops was considered good practice, as the spans were from one hundred and ten to one hundred and twenty-five feet, and the wires light. Much heavier wires and insulators are now used and the spans are longer, so that the tendency is to increase the size of the poles. The new line now under construction by the municipal light and power plant in Seattle is using fifty-five-foot poles with eleven-inch tops, on spans of four hundred and forty feet. On the Nooksack Falls line, forty-five-foot poles with nine-inch tops, on spans of one hundred and fifty or two hundred feet are used, which is about the same as on the 1904 lines of the Seattle-Tacoma Power Company and the city plant. It is thus apparent that the trend is toward longer spans, with fewer and more substantial supports.

The construction details of the pole top vary considerably in the different systems. In some installations in Utah and Montana the pole top pin is driven into a hole bored into the top of the pole. In the wet climate of the Northwest this construction would be apt to cause rotting of the core of the pole at the top, so that the pole top is always pointed to shed the water and the pin fastened to the side of the pole. The experience on every system using wood pins has been that after a number of years the pins are apt to soften or burn. The leakage of currents over the insulator to the pin forms nitric acid from the nitrogen in the air and the hydrogen and oxygen in the moisture, and the acid eats into the pin until the latter becomes quite pulpy. Wooden pins are usually carefully dried and boiled in paraffin or linseed oil, but even then they will begin to soften and burn in from five to ten years, depending on the line voltage. The Seattle municipal plant had a great deal of trouble a few months ago from charring and burning of wooden pins at the point of contact with the insulators, during the time that they were running 55,000 volts on their 45,000 volt line. In this case the leakage currents were so heavy that a high temperature was produced at the threads of the pin, due to the ohmic resistance to the passage of the current at this point. At the lower part of the pin and on the cross arm there was not so much burning, due probably to the accumulation of dirt and organic matter, and to the fact that the large wet surface offered a lower resistance.

Iron pins give entire freedom from such troubles, and also provide the strength necessary for long spans and heavy wires. There are several types of iron pins now in use. The simplest is what is known as the pipe pin, consisting usually of a short length of two-inch extra heavy wrought iron pipe swaged down at one end and cemented in the insulator. Another type consists of a cast iron cone with a steel bolt up through the center and screwing into a nipple which is cemented in the insulator. This type is used on the new city line. A third type consists of one solid malleable iron casting with tapering cross ribs above the cross arm and a round pipe shank or a bolt extending through the cross arm. This is held down by a through bolt or a bolt underneath the cross arm, and may be threaded and screwed into the insulator. The Northern Colorado Power Company has a pin of this type held down by a U-bolt extending around the outside of the arm. These are the three general types of iron pins now in use in the Northwest. The pipe pin costs from fifty-five to sixty cents, the bolted cone pin about fifty cents, and the malleable cast iron pin from twenty to forty cents, depending on the design. The pipe pin has the great advantage of simplicity and absence of bolted parts, and requires no pole top fixture; but, on the other hand, it requires at least a two and one-half inch hole in the cross arm, which necessitates a larger arm. As the insulator must be cemented on the pin, it is necessary to change the pin as well whenever an insulator is broken. With the bolted cone pin only a five-eighths inch hole in the cross arm is necessary, and as only the small nipple is cemented in the insulator it is not necessary to change the pin when

renewing an insulator. Some sort of casting or fixture is necessary at the pole top in order to use this type of pin, and the cost of this brings the cost up as high as the pipe pin. The malleable cast iron pin is simply of one piece, and with a threaded head it need not be changed in renewing insulators. If properly designed, it is as strong as the other types and is very much cheaper. By a little change in design it may be bolted directly to the pole top. In general, the practice is to design the pin so that it will bend over before the elastic limit of the wire is reached, so that, in case of an unbalanced strain in the line, the pin will bend and prevent elongation of the wire. The extreme rigidness of the bolted cone pin may, in such a case, prove to be a disadvantage.

Cross arms are invariably of straight, well seasoned fir, and should be painted or given a coat of preservative. Their cross section varies from four by six inches in short spans to six by eight inches with long spans and heavy wires.

The insulators used are usually of a standard type and made of porcelain. The city line has a few glass insulators, but while these are electrically satisfactory they are very easily broken and are rarely used. Experience proves that it is advisable to test all high voltage insulators before accepting them, especially for line work for over 30,000 volts. The cost of this test should not exceed five cents per insulator. The test voltage should be made at least double the line voltage. The insulators are set head down in a trough of water deep enough to cover the wire groove, and sufficient water poured in the pin hole to cover the threads. A metal rod is then put into the pin holes and the test voltage applied between this rod and the water in the trough. Where the insulator is made of several shells cemented together, each shell should be tested separately for its share of the voltage. It is of extreme importance that the porcelain in high tension insulators be of good quality and free from cracks or pits. On the Snoqualmie system, two different insulators of almost exactly the same shape are used—white imperial porcelain on the main lines and chocolate colored porcelain insulators on the Everett line. The porcelain in the latter was not quite so good as used in the white insulators, and they would not hold up under so high a voltage, even though they were of the same design. The fracture of high grade porcelain shows a vitreous and almost polished surface. The glaze possesses no insulating value, but is simply to prevent the adherence of dust and dirt, and hence it should cover the entire outer surface. High tension porcelain should be thoroughly vitrified and non-absorbent. A test for porosity is obtained by soaking the porcelain in ink; if non-absorbent, the ink should be easily washed off with water.

Spans. The subject of spans in transmission lines has been given considerable attention by engineers in the last few years. During the early days of high voltage work short spans were thought necessary in order to insure against breakage of wires, and as the wires were usually small and the spacing between them not over a few feet, long spans would have given trouble. It has been found, however, that wires never break of their own accord if properly strung and if all kinks are replaced by splices, and that if a spacing of six or seven feet is used there is no danger of the wires swinging together. Large wire having great tensile strength is now used and long spans are operated with safety. The weak point in a transmission line is its point of support, and anything which reduces the number of supports decreases the number of weak points and also the loss from leakage. The great advantage lies in the reduced cost. This reduction in cost, however, will not hold if the length of span is made too great, as it then becomes necessary to build expensive towers and heavy construction in order to take the strain safely. In order to determine the most economical length of span, the procedure outlined by D. R. Scholes is the simplest and may be applied to wood poles as well as to steel towers. A curve is plotted with cost per mile and length of spans as co-ordinates. As an example, let us assume a 55,000 volt line. With spans of one hundred to one hundred and fifty feet, a five-foot spacing between the wires is good practice. A light, malleable

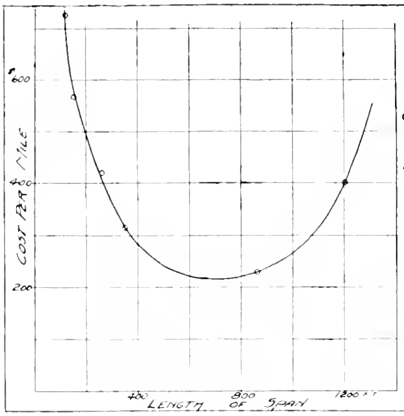


FIG 11
CURVE SHOWING THE COST PER MILE IN RELATION TO LENGTH OF SPAN
55000 volt Line
Does not include cost of wire curves or special fixtures

cast iron pin, four by six inch cross arms, and forty-foot poles with eight-inch tops would be used. The labor of setting and framing the pole will vary considerably with the locality, but may be estimated at $6.00. We then have the cost per pole:

3 insulators and pins @ $1.80	$5 40
1 cross-arm, braces, and bolts	0 75
1 40-ft. pole @ 0.10	4 00
Labor	6 00
	$16 15

With thirty-five poles per mile (one hundred and fifty foot spans) this comes to $565.25 per mile, and with forty-five poles (one hundred and eighteen foot spans), $726.75 per mile. For spans of two hundred and fifty to five hundred feet a heavier construction is needed, with a spacing of at least seven feet between wires, similar to the new line of the municipal plant in Seattle. At least fifty-foot poles with ten-inch tops are needed, with five by seven inch cross arms. A substantial design of pin is needed, well fastened to the cross arms. Taking a design similar to that on the city line:

3 insulators and pins @ $2.20	$6 60
1 cross-arm, with braces and bolts	1 20
Pole-top fixture	0 20
1 50-ft. pole @ $0.13	6 50
Labor	6 50
	$21 00

With twenty poles per mile (two hundred and sixty foot spans) the cost will be $420.00 per mile, and with fifteen poles (three hundred and fifty foot spans), $315.00 per mile. This construction if carefully designed can be used up to five hundred or six hundred feet. Although single poles are used for spans up to nine hundred feet in California, the opinion here seems to be that with spans over seven hundred feet an A-frame should be used with double construction. The cost of this may be estimated at:

6 insulators and pins @ $2.20	$13 20
2 cross-arms, braces and bolts, etc	3 00
2 60-ft. poles	15 00
Labor	11 00
	$42 20

With six poles to the mile (eight hundred and sixty foot spans) the cost will be $253.20. If the line has many bad curves this figure will be considerably increased. With spans over one thousand feet, a four pole tower is recommended. This will cost:

12 insulators and pins	$26 40
Timbers and framing	9 00
4 60-ft. poles	30 00
Labor	25 00
	$90 40

With twelve hundred foot spans the cost will run up to $400.00 per mile, which is past the economical point, as seen on the curve in Fig. 11. These figures are only approximate, and are given chiefly to illustrate the principle involved. The influence of curves, character of country, etc., may make long spans impossible in some parts of the line, which will make the most economical span shorter. On the other hand, a mountainous country affords excellent opportunity for spans from hill-top to hill-top, making a large saving in clearing trees on the right of way, etc. Each particular line must be worked out with reference to the local conditions.

Switching and operation. Some diversity of opinion exists as to the best scheme of switching. The Electron system with two 0000 copper lines and 55,000 volts uses automatic circuit breakers at each end of its transmission lines, and normally these lines are not connected in multiple on the high tension side. A short circuit on the system which lasts only a few seconds will not open the breakers, as the latter are protected by relays; but a short circuit which holds on will open the line at Electron and also at the substation in order to prevent feeding back into the short circuited lines. The Snoqualmie system with 0000 aluminum lines at 30,000 volts has no automatic release on its high tension lines, except where small substations or branch lines tap the main system, and on the switches used for connecting the lines in multiple. A short circuit coming on either line usually releases the multipling switches. The operator at the falls can then usually see from the line ammeters which line the short circuit is on, and opens that line with the oil switch. If for any reason it is not apparent which line is in trouble, the voltage is lowered and the short circuit is "pulled' until it is burned off, but both lines are never cut out. Automatic circuit breakers are used between the steam generating station in Seattle and the transmission system so that the steam plant will not feed back into the short circuited high tension line. This non-automatic method of operation has given excellent results on this system, as most of the line short circuits can be burned off within one or two minutes at the most, and the only effect at the substations is a bad dip in the voltage. This is much better than shutting down for the five or ten minutes necessary to switch out the bad line, as all synchronous apparatus is then thrown out and must be started up and synchronized all over again. Long lines with comparatively small wires are more easily handled in this way. With a short line, high voltage, and very heavy copper a surge may occur with a bad short circuit which will have a destructive effect on the windings of the generators unless their impedance is high. This country is rapidly developing, and within a few years much heavier capacity lines and higher voltages will be employed, and a more complex system with a number of stations tied together will result. More or less automatic apparatus will then become necessary. The plans of the new Seattle municipal system shows the best practice for automatic line protection. They expect to use both overload and reverse current relays in connection with automatic circuit breakers. Unless they are well made, and judgment and care used in their installation and use, the relays may not give satisfaction. The primary object of the relay is to control the automatic release of the circuit breakers. The ordinary overload relay may be set for a certain time limit, and if the overload continues for that time the relay will trip the breaker. If a heavy short circuit comes on the line when there are only a few generators in service, the voltage may be pulled down too low to operate the relay, and the design must be such as to insure operation at very low voltages and power factors. Reverse current relays are used at the substation end of the line to prevent feeding power back into the defective line where two lines are operated in multiple. Relays should open the short circuited line at each end quickly enough to prevent synchronous apparatus on the system from falling out of step; but at the same time they should not operate at slight surges caused by an operator making a slight miss in synchronizing. During the synchronizing of generators at Electron, it is the practice to cut out the relay on the generator circuit breaker so that a bad throw will trip out the incoming machine instantly without disturbing the system. The general conclusion to be drawn from switching practice in the Northwest is that non-automatic operation is satisfactory, and will give good results on systems where the line conductors are not too large and the voltage not over 50,000 volts. In very large and complex systems handling large amounts of power at short distances, automatic protection becomes necessary.

SWITCHBOARDS FOR ROTARY CONVERTERS[1]

BY THEO. F. JACK.

A rotary converter, in construction, is quite similar to a direct current generator, with the addition of collector rings, connected to the armature windings at points having the desired phase relation. The chief applications of a rotary converter (or more familiarly a rotary) is to convert either alternating in direct current, or direct into alternating current, the first application being the most common. When converting A. C. to D. C., a rotary is said to be operating direct; when converting from D. C. to A. C., it is said to be operating "inverted." The modification in switchboards for either case will be discussed later. The frequency of a rotary is determined by the design, as is also the D. C. voltage. The voltages on the D. C.

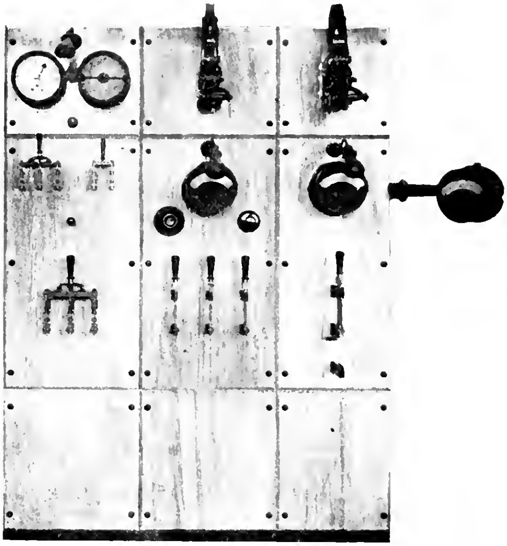


Fig. 1. A Three-Panel Board of Standard Type for the Control of a 3-Phase Rotary Converter.

and A. C. sides differ by a fixed ratio. For circuits of a true sine wave form, this is practically the ratio of the maximum value to the square foot of mean square value of the A. C. wave form. For polyphase machines, there is a difference due to the phases. Rotaries may be either shunt or compound wound, the latter being the most common.

From a switchboard point of view, a rotary converter is considered as two separate machines, namely, a direct current generator and a synchronous motor. It is customary to provide separate panels for each side of the machine. Panels for controlling units of 100 k. w. or smaller, may be combined into one panel, also panels for larger units, where the A. C. side is controlled by electrically or mechanically operated remote control switches. The most general and satisfactory method is to provide separate panels. These are usually built up so as to form a complete board, with the A. C. panels on one end and the D. C. on the other. This arrangement keeps the A. C. and D. C. circuits separate and avoids crossing of leads or bus bars.

Fig. 1 shows a standard type of rotary converter switchboard, such as would control a 500 k. w., 3 phase, 550 volt, D. C. machine. Fig. 2 is the diagram of connections applying to this board. The A. C. panel contains an ammeter with its switches, a power factor meter, starting motor switch, synchronizing rheostat switch, main switch and synchronizing lamp, plug and receptacle. An A. C. voltmeter is seldom furnished, as the A. C. voltage can be quickly calculated from the D. C. as shown on the D. C. voltmeter.

Referring to the diagram, it will be seen that the alternating current passes through a bank of delta

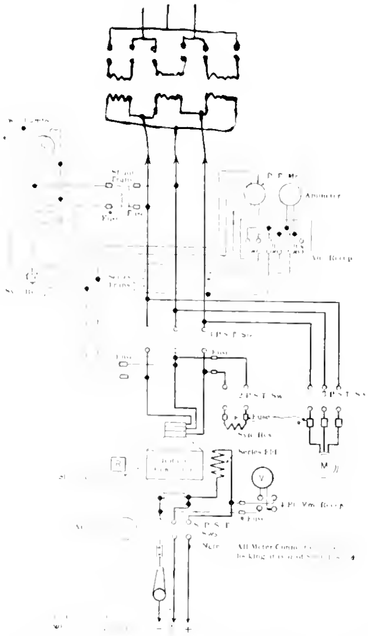


Fig. 2. Diagram of Connections of Switchboard Shown by Fig. 1.

connected, lowering transformers, connection being made to the machine by the three pole, S. T. main switch on panel. It is good practice to connect transformers, when serving rotaries, in delta, both on high and low tension sides, as such an arrangement facilitates the cutting out of one transformer in case of trouble or repairs. Sometimes switches are provided on both sides, being connected inside the delta, so as to facilitate the speedy isolation of any transformer.

Where it is desirable to operate rotaries in parallel, they should be bussed on the D. C. side only. Each machine should have its own bank of transformers, and although several banks of transformers may be bussed on the high tension side, a similar arrangement on the low tension side should be avoided. It is impossible to operate rotaries on parallel satisfactorily and equalize the load when bussed on both A. C. and D. C. sides. There have been cases where it was thought desirable to bus the low tension side of all transformers and operate the rotary in parallel with both A. C. and D. C. bus bars, but, in order to obtain

[1]Paper read before Seattle Section of American Institute of Electrical Engineers, February 20, 1909.

satisfactory results, it was necessary to insert specially designed choke coils in series with each A. C. machine lead. The purpose of those choke coils being to retard the flow of correction currents, which would otherwise exchange between unequal machines. The insertion of these choke coils lowers the efficiency of the converter group, as well as affecting the power factor and compounding.

It is customary to connect each rotary to its bank of transformers, with a main switch for interrupting the circuit. Sometimes this switch is located in the high tension leads to the transformers, the low tension leads being connected solid to the machine. This is desirable, if the units are of large capacity. In order to save cable the banks of transformers are placed as close as possible to their respective machines. With such an arrangement, considerable cable can be saved, especially if the machines are six phase and of large capacity. It is recommended that a small slab, holding two single pole switches and mounted close to transformer be provided for the low tension side, so that any transformer may be isolated, or the entire low tension circuit opened. This is necessary if the machine is started from the D. C. end and it is desirable to reduce the starting current to a minimum, otherwise excessive current may flow, due to the magnetizing current required by the transformer secondaries.

Automatic protection in the low tension A. C. circuit is very seldom required, and rarely provided. The circuit breaker on the D. C. side affords ample protection for the machine, and fuses or a circuit breaker in the high tension leads give the desired protection to the transformers. If sufficient care is exercised in running the low tension A. C. leads, there is no necessity for placing automatic cutouts or fuses in the circuit. Where a system, as shown by Fig. 3, is used, an automatic feature should be added to the oil circuit breaker.

The only indicating instruments required on the A. C. panel, are an ammeter and a power factor meter. One ammeter is sufficient for polyphase machines, as the phases are normally balanced. Suitable ammeter switches should be provided, so that readings of each phase can be obtained. These switches should be so designed as to not open the series transformer circuits when operated. A power factor meter is preferable to an indicating wattmeter, as it enables the attendant to properly adjust the field strength with regard to power factor and avoid calculations, which obtain when a wattmeter is used.

The armature of a rotary converter is usually brought to synchronous speed before paralleling, that is, if the method of starting selected requires synchronizing. This is usually done by means of an induction motor, the motor being direct connected to the armature shaft, and in systems similar to Fig. 2, is controlled by a single throw switch on the A. C. panel. In earlier designs, a double throw switch was provided for this purpose, connecting the motor to the starting and running voltages required. This method has been greatly simplified by designing the motor windings so it could be thrown on full voltage when starting. Sometimes D. C. starting motors are used, also single phase series motors, the latter being required with four pole rotaries.

In addition to the starting motor, a resistance load should be supplied, to act as a brake and slow down the acceleration of the rotary's armature, so that it may be more readily synchronized. This resistance, usually of inductive type, is called a synchronizing resistance and is controlled by a two pole, S. T. switch on the A. C. panel. Some engineers insist on a field switch being added to the board, so that in case the machine is built up with the wrong polarity, this field switch can be opened and closed quickly, allowing the armature to "slip a pole" and give the correct polarity on the D. C. side. The disadvantages of this field switch are greater, however, than its advantages, chief among the dangers being the possibility of its being opened at the wrong time.

It is customary to omit the field switch and if the machine has the wrong polarity, the operator opens the A. C. switch and resynchronizes till the machine is of the proper D. C. polarity.

For synchronizing purposes, either lamp or the synchroscope can be supplied, and it is good practice to furnish both. The lamp serves as a check on the synchroscope and as a means by which the speed of the incoming machine may be judged, the synchroscope giving an indication of the point where the frequencies of the incoming machine and the line coincide and indicating to the operator the proper instant for closing the main switch. Synchronizing with the lamp alone is very unsatisfactory and unreliable, which is more apparent the larger the unit to be thrown in step. There are two ways of connecting the synchronizing lamp, called "dark" and "light" methods, depending on whether the lamps are to be dark or bright at the point of synchronizing. Of the two, the dark method is to be preferred, as giving more accurate results.

The use of synchroscope for throwing A. C. machines in step, is much more satisfactory than lamps. The synchroscope indicates clearly the exact point of synchronizing, and any difference in frequency which would not be shown by lamps is clearly indicated by this instrument.

There is on the market an instrument which will automatically synchronize an A. C. generator or rotary converter, and perform the operation without failure or disturbance to the distributing system. This instrument is so designed that it will not throw the incoming machine in circuit unless both the frequency and voltage are correct. One automatic will serve any number of machines. Its use eliminates all the chances for error inherent with manual operation, and for large installations, is well worth the extra expense. The use of an automatic synchronizer necessitates the use of electrically operated switches in either the high tension or low tension leads of the lowering transformer. In most cases, it is cheaper and simpler to install the electrically operated switch in the high tension leads, although instances may develop where it is necessary to place electrically operated switches in the low tension leads. Fig. 3 shows a switchboard provided with automatic synchronizer. The A. C. panel containing automatic synchronizer and controlling apparatus is shown as the first panel at the extreme left of the board, and it will be noted that the D. C. end is arranged for controlling the positive side

only of the machine. The negative and equalizer busses would be placed near the machine, as will be hereinafter explained.

Methods of starting and paralleling without synchronizing are in use, and some are giving excellent satisfaction. The elimination of synchronizing with its attendant evils, is much to be desired, especially where a number of units are paralleled daily. Of these methods, we will discuss two that are in use.

In the first of these the A. C. panel is the same as shown by Fig. 1, except that the starting motor switch, synchronizing switch and synchronizing lamp and receptacle are omitted. A separate starting panel is provided and placed conveniently near the machine and switchboard. This panel contains, for a three phase or a six phase rotary, two three P. D. T. or six S. P. D. T. switches. These switches are connected to certain taps, provided on the lowering transformers, so

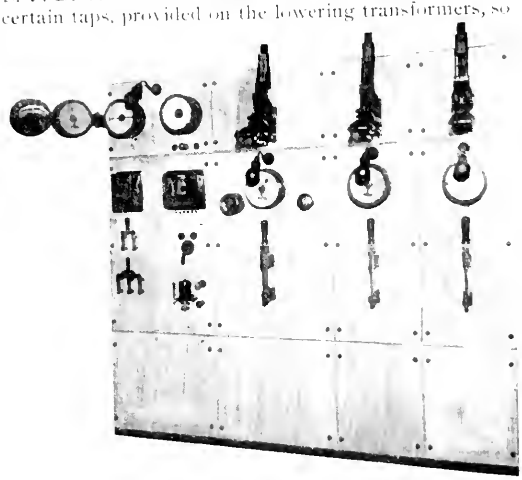


Fig. 3. Three-Panel Rotary Converter Board With Automatic Synchronizing Apparatus Mounted on A. C. Panel.

that three different voltages may be impressed on the rotary's armature in starting. Two field switches are provided—one, a two pole switch, is mounted on the A. C. panel, the other, a four pole switch, is mounted in the frame of the machine, being so connected that, when open, the shunt field coils are disconnected in groups. This is necessary on account of the high voltage induced in these field coils by the powerful rotating field obtained in starting. To start, all switches are opened; the A. C. switches giving the lowest starting voltage are closed, and as the armature increases its speed, the other voltages are thrown on in succession. When full speed has been reached, both field switches are closed and the usual method of putting the machine on the D. C. bus is followed.

This scheme works out fairly well for small units, but for large ones, has the following disadvantages:

First—Additional cost of taps on lowering transformers.

Second—Additional wiring and switching.

Third. Heavy starting current required, unless the machines are provided with prohibitively light dampers.

The last named is to be seriously considered in the case of large units. In order to decrease the starting current, light damping grids must be used on the pole tips. This decreases the ability of the machine to stay in step on overload, also increasing the inherent characteristics of the rotary to hunt.

With the second method, the A. C. panel is the same as Fig. 1, except the main switch is special double throw and the motor starting switch, synchronizing rheostat switch and synchronizing lamps, plug and receptacle are omitted. Three resistances (preferably of ohmic type) are furnished for the A. C. side, being connected so as to be in circuit when the main switch is thrown half way in. They are of sufficient capacity so as to limit any passing current to the normal running current of the rotary. A starting switch and resistance are furnished on the D. C. panel, and means are provided for separately exciting the shunt field. To start, all switches are opened, the D. C. circuit breaker is then closed, then the negative switch and the starting switch. Throwing the starting switch on the first point connects both shunt field and armature to the circuit, the field being connected so as to receive full voltage. This arrangement not only simplifies the board by omitting the field switch, but eliminates the possibility of the attendant throwing the armature in circuit without first exciting the shunt field. The synchronizing rheostat may be thrown in circuit after the armature starts to revolve.

When the armature has attained synchronous speed, the main A. C. switch is thrown in the first position. This connects the rotary to the A. C. circuit through a resistance. If the rotary and line are out of phase, a corrective current will flow at the instant of throwing the switch. This current will pull the armature into step and lock it there. The value of this corrective current depends on the difference in phase and voltage of the line and rotary at the instant of closing the circuit, but it is limited at any time to full normal current of the armature by the resistance in circuit. When the armature has fallen in step, the main switch can be thrown to the running position, in which position the resistance is short circuited. In using this method of starting, it is advisable to adjust the rotary so that its frequence will be slightly above that of the A. C. system before the A. C. circuit is closed. This will permit the armature to fall into step with a minimum exchange of current. The armature can be thrown in on the A. C. circuit at speeds lower that synchronous, but a greater corrective current will flow; also stress will be placed on the field coils by the shifting field which may cause damage.

While this method has the disadvantages of all methods of starting from the D. C. end, in that it requires a source of direct current to start, it does not have any of the disadvantages mentioned of the scheme shown by Fig. 4 and has advantages which will prove attractive when direct current for starting can be obtained.

The direct current side of a rotary may be controlled by a panel such as would be furnished with a similar D. C. generator. Referring to Figs. 1 and 2, you will note that the D. C. panel contains a single pole automatic overload circuit breaker, an ammeter, voltmeter, voltmeter plug switch, field rheostat and main switches. Where a number of large rotary converters are to be operated in parallel, the question of automatic protection on the D. C. side should be given careful attention. It is often advisable to add

to the regular overload circuit breaker, a reverse current trip and an overspeed trip. The reverse current feature should be as sensitive as possible, preferably of the shunt operated relay type, and should trip the breaker on any reversal of current on the D. C. side. The overspeed device should be attached to the end of the armature shaft and so adjusted that the centrifugal action of any speed above normal would close a tripping circuit and open the breaker.

The D. C. meters should be of the polarized type and so connected that they will indicate only when the machine is built up with the proper polarity. Where a number of units are to be installed, it is recommended that the D. C. panel contain an ammeter only, the voltmeters being placed on a swinging bracket at the end of the board.

The field rheostat is usually mounted on the D. C. panel on account of lack of space to place it on the A. C. panel where it really belongs. Having the rheostat on the A. C. panel is a convenience to the operator, enabling him to more easily read the power factor meter when adjusting the field. Where the A. C. and D. C. panels form separate boards, removed from each other, it is advisable to place the field rheostat on the A. C. panel.

With installations of small units, the positive, negative and equalizer switches may all be mounted on the D. C. panel, with busses on rear, or the equalizer switch may be placed on a pedestal located near the machine with the equalizer bus run between pedestals, under the station floor. In any case, it is preferable to use single pole switches, so that the series field can be thrown in circuit and partly excited before the machine is connected to the bus. For large installations, of 500, 1,000 or 1,500 kw. units in railway installations, a single bus system for the D. C. panels can be used to great advantage and a considerable amount of cable thus saved. With this system, the board controls the positive circuit only, requiring but one bus bar and one polarity on the rear of board.

The negative and equalizer circuits are controlled by switches placed on suitable pedestals near the machine, a circuit breaker being provided in addition to the switch for the negative circuit, and equalizer bus bars can be located beneath the station floor and if possible directly under the pedestals and machines. This reduces to a minimum the length of negative and equalizer cable, necessary to make connections to bus bars. A switch board of this type is shown by Fig. 3, from which you will note the simplicity of arrangement of the D. C. panel resulting in a saving in cable, ducts and losses.

It is sometimes advisable to start from the direct current end and avoid the additional expense of either A. C. or D. C. starting motors. This may be worked to great advantage in handling of large units. To accomplish this, the switchboard is so arranged that the rotary may be started as a shunt wound motor. With compound rotaries, this may be easily accomplished by arranging connections so that the starting current on the series field side will flow through the equalizer lead with the series field out of circuit. The source of starting current may be obtained from the D. C. bus bars, when there are other machines running, but this brings out this disadvantage, in that it is necessary to provide at least one rotary with a starting motor to get it in operation before the others can be started. In some cases the starting current can be obtained through the trolley from another station. The best arrangement is to install a small motor generator set to provide the starting current. If this is done, the switchboard should be laid out with a separate bus for starting current and a special or "starting" panel, by which this current can be controlled. If the units are all of the same capacity, one starting switch and resistance will be sufficient. The negative and equalizer switches can be made double throw, for making the starting connections. The circuit breaker on the starting panel can afford protection in starting, and an ammeter in the same panel should indicate the current value of the starting circuit.

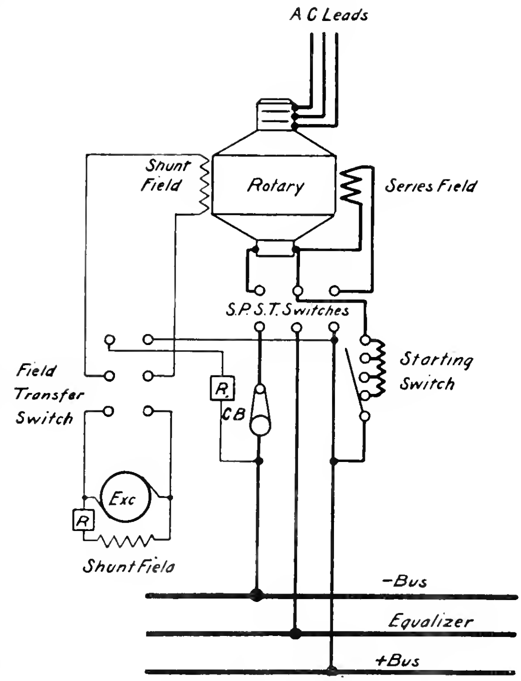


Fig. 4. Diagram of Connections for Direct Current End of an Inverted Rotary Converter.

Switchboards for control of rotaries operating inverted, or periodically direct and inverted, differ from the ordinary board, chiefly in the arrangement of instruments on the D. C. panel. Fig. 4 gives an idea of the switch connections of the D. C. end of a 300 kw., 550 volt, 3 phase, inverted rotary. The A. C. panel is the same as Fig. 1, but the D. C. panel contains a field transfer switch, exciter, rheostat and starting switch in addition to the regular complement of D. C. instruments. The field and starting switches are used in starting. The rheostat in the converter field is used only on starting, and when the machine is running, this rheostat should be cut out, field regulation being obtained through the exciter field rheostat.

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Single Copies, Current Month	each	.10
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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE

PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Electricity in the Northwest

The Pacific Northwest is inviting the world to view the great strides that have been made in converting what but recently was a trackless wilderness into one of the most productive regions of the earth. Youth such as this, has no historical event to be commemorated. Therefore, the purpose of the Exposition to be held at Seattle during the coming summer is primarily one of education. The exhibits are the great natural resources with which this region has been so lavishly supplied. Fertile lands, dense forests, productive mines, streams teeming with fish and supplying abundant water for power and irrigation, all afford lessons of unparalleled interest to those whose lands have long been stripped of these bounties of Nature.

The water, last named, because most recently used, is capable of the greatest development, and on its wise utilization depends the material prosperity of these people. As an irrigator it is bringing forth the raw products, as a power source it is turning the wheels of industry. Within less than a decade the futile roar of the waterfall has been supplanted by the busy hum of the generator, and the power waste of multitudinous streams harnessed to the needs of man. In Rainier's glaciers on the summit of the Cascades is locked the potential energy to furnish the myriad of lights of this Exposition, to transport its visitors and to perform the many duties demanded by this service.

The region has also its coal measures, this fuel being more plentiful here than elsewhere on the Pacific Slope. There are many small electric power plants as well as auxiliaries to the larger ones that are operated by steam.

The key that has unlocked this great storehouse of Nature is the enthusiasm of its people as backed by the monied men of the country. This spirit of zealousness is indicated by the active existence of the Northwest Electric Light and Power Association, which is co-operating with the Seattle section of the American Institute of Electrical Engineers in extending a hearty welcome to visiting electrical men. The high standing of the latter is attested by the excellent papers that have been read before it and published in our columns. These two bodies are desirous of letting the world know the capabilities of their section. They will have a joint meeting at the Exposition early in September and invite all electrical men to plan their trip for that time. Oregon, Washington, Idaho, British Columbia, and Alaska will have representatives to show the power possibilities of their respective districts, and it behooves those of us who have not yet learned it all to be there.

CURRENT COMMENT

Electrification of the Northern Pacific Railway on the Montana division is being investigated.

Another substitute for rubber for insulation purposes is claimed in the wax obtained from the candelilla plant in Mexico.

Electrical stimulation of wheat increased the crop from 26.15 to 37.5 bushels per acre in some recent experiments in England.

Nitric acid from the air is to be obtained by four plants in Norway which will be completed by the end of 1910. These plants will use the Birkland-Eyde process.

Electric sights on rifles are being tried out at the arsenal at Springfield, Mass. Small electric lights, supplied with current from a storage battery, illuminate the rifle sights so that accurate aim can be taken in the dark at close range.

A mono-rail system is to be installed by the Pelham Park & City Island Railroad Companies between Bartow Station and Beldon Point, the Bronx, New York City. The system is purely experimental and will employ electric power.

Wireless communication across the Pacific was maintained constantly during the latest trip of the army transport Sheridan, which was in direct communication with San Francisco until it reached the 180th meridian when communication had been opened with Honolulu. Off Midway Island conversation was conducted with Nagasaki, 2,800 miles, and Honolulu.

A merger of Washington power companies is to be effected by the Puget Sound Power Company, which has been incorporated with a capital of $80,000,000 as a holding company for all the electric light, power and railway companies in northwestern Washington. Extensions are planned that will give continuous electric railway service between Portland, Oregon, and Vancouver, British Columbia.

Sunspots are vortices of negative electricity in the atmosphere of the sun, according to Dr. Geo. E. Hale, director of the Carnegie Solar Observatory at Mount Wilson, California. The cathode rays, or particles of negative electricity emitted by the vapors of incandescent metals, produce a magnetic field if they are whirled around. These have been recognized in the spectra of the sun and are evidently closely identified with the earth's magnetic field.

The Tokyo Electric Light Company intends to establish a second power station. The work of construction is estimated at $5,000,000 gold, and it is believed that the stat.on, when completed, will be capable of supplying electric current to the extent of 35,000 horsepower. The power of the company is at present 22,500 horsepower, of which 18,000 horsepower is supplied to the general public. Altogether, the company will shortly be able to supply 57,000 horsepower to the public.

The American Electrochemical Society will hold its annual meeting at Niagara Falls, Canada, on May 6, 7 and 8. In addition to a number of papers on electrochemical analysis, there will be presented a symposium of papers on the electrometallurgy of iron and steel by various experimenters.

Electric power for the Homestake Mine at Deadwood, South Dakota, is to be furnished by a 5000 k. w. hydro-electric plant, which will be erected on Spearfish creek. A fall of 700 feet is to be obtained by conveying the water through underground tunnels for over five miles. These tunnels, eight in number, will each be from 2000 to 4000 feet long.

A 50-inch spark is produced by the Heinze induction coil which has recently been produced for experimental work. The primary core is 6 feet in length, 4 inches in diameter and weighs 210 pounds; it consists of 748 turns of No. 10 magnet wire. A 10-foot micanite tube, 1½ inches thick, forms the insulation between the primary and secondary. The latter consists of 138 miles of No. 32 magnet wire wound on a series of mica-insulated coils. The commutator is motor-driven and designed so as to allow no inductive "back kick."

An amalgamation of Japanese electric firms, the Shibaura Seisakujo factory of the Mitsui family with a capital of $500,000 and the Tokyo Electric Company may be made by the General Electric Company and Japanese capitalists, with a paid-up capital of $350,000. The conditions of the amalgamation are not yet known, but it is believed that the capital of the amalgamated company will be increased to $2,000,000, 51 per cent of the shares being allotted to the American company in consideration of the acquirement by the new company of all the patents owned by the General Electric Company.

An electric power plant for Bogota, Columbia, is proposed, according to Consul-General Jay White. At present the streets of Bogota are not lighted, because the electric company, which has its power station 20 miles from the city, has not sufficient power to supply the necessary electricity for both house and street lighting. The site of the new plant is three miles from Bogota, and 656 feet above the level of the city. The city could be well lighted with 250 arc lamps or with 25 arc lamps and 1,000 25-candlepower incandescent lamps. The cost for the installation of these systems is estimated as follows: The all-arc-lamp system, about $47,000; the arc and incandescent system, about $42,000. If, as it is said, the government offers about $25,000 per annum for lighting the streets, the contract for building the new installation should be a good business for a small company. In addition to the offer of the government for street lighting, it is estimated that a yearly income of $10,000 would be derived from renting power to private parties. Deducting the working expenses, this would leave an annual net revenue of over $24,000.

PERSONAL.

H. B. Logan, president of Dossert & Co., New York is in San Francisco.

John G. Sutton of the John G. Sutton Company, San Francisco, returned Monday from Vancouver.

Frank T. Clarke, formerly with the engineering department of the Commonwealth Edison Company, Chicago, is now with the Pacific Gas and Electric Company, San Francisco.

B. L. Kerns has been placed in charge of the Spokane, Wash., branch of the Westinghouse Electric & Manufacturing Company, after six months service in the Seattle office.

Robert F. Beebee, proprietor of the Gridley Electric Light and Power Company, at Gridley, Cal., was killed April 13th at the power house by coming in contact with a 15,000 volt wire.

H. C. Thaxter, former manager of the Standard Electric Works, San Francisco, is now connected with the engineering department of the San Francisco office of the Allis Chalmers Company.

T. E. Bibbins is now assistant Pacific Coast manager for the General Electric Company with headquarters in San Francisco, having been advanced from the position of manager of the supply department.

F. H. Poss, of the San Francisco office of the Holophane Company and the Benjamin Electric & Manufacturing Company, has returned from a trip of four weeks which included Seattle, Vancouver, Salt Lake City and Los Angeles.

F. L. Pierce, vice president of the Cutler Hammer Manufacturing Company, Milwaukee, Wis., has been spending several weeks in Southern California and expects to reach San Francisco on his return trip to the East about April 28, 1909.

Robert Kuhn, secretary of the American Electrical Heating Company, Detroit, Mich., spent the past week in San Francisco, and left for Del Monte on Friday, where he will attend the meeting of the Electrical Jobbers' Association of the Pacific Coast.

S. G. McMeen, engineer for the Home Telephone Company, San Francisco, will deliver the second annual address before the chapter of the Tau Beta Pi at the University of California, on May 5, 1909. He will speak on the development and application of the telephone.

J. W. Perry, general manager of the electrical department of the H. W. Johns-Manville Company, with headquarters at New York, spent the past week in San Francisco on his annual trip to the Pacific Coast. On April 15th he was the guest of the Electrical Club of San Francisco at luncheon when, in response to the request of the president he reviewed conditions in the electrical business as he has found them on his present trip.

O. J. WAKELING, WITH THE CALDWELL BROTHERS COMPANY, SEATTLE, WASH.

The Journal takes pleasure in introducing to the machinery trade of the Northwest, a young business man from San Francisco, whose capabilities should be of material assistance in furthering the prosperity not only of the company with which he is connected, but also of the region which it is supplying. Mr. O. J. Wakeling has resigned his position with Baker & Hamilton of San Francisco to become general sales manager for The Caldwell Brothers of Seattle and Tacoma, Washington. This firm carries one of the most complete lines of machinery in the Northwest, including steam engines and boilers, machinery tools, mining machinery of all kinds, hydraulic equipment, contractors' supplies, sawmill and woodworking machinery, representing many of the best manufacturers in the various lines. Among these are the Dodge Manufacturing Company, Buffalo Steam Pump Company, Ballwood Automatic Engines, A. S. Cameron Steam Pump Company, Cambria Steel Company, English Iron Works, Gould Manufacturing Company, Houston-Stanwood & Gamble Company, Hendrie and Bolthoff Manufacturing and Supply Company, Ingersoll-Rand Company, La Blonde Machine Tool Works, Pennsylvania Boiler Works, Regal Gasoline Engine Company, Risdon Iron Works, Riffe Hydraulic Engine Manufacturing Company, Taylor Iron and Steel Company, Wellman, Seaver, Morgan Company.

O. J. Wakeling.

Mr. Wakeling, by virtue of his wide and varied experience, supplemented by his long service in charge of the machinery department and engineering work of Baker & Hamilton on the coast, is eminently qualified for his new position. After graduating from the Department of Electrical Engineering at McGill University, he entered the employ of the Michigan Electric Company of Detroit, Michigan. Later he was with the Kendrick Gold Mining Company in South Carolina and Alabama, and then with the Richmond Railroad Company on Cape Breton Island. After a year's service with the Salt Lake Electric Company he entered the employ of Baker & Hamilton of San Francisco, which position he has just left with the good wishes of his many friends for his continued success.

NORTHWEST ELECTRIC LIGHT AND POWER ASSOCIATION.

The annual convention of the Northwest Electric Light and Power Association will be held at the Alaska-Yukon-Pacific Auditorium September 7th, 8th and 9th. The executive committee at a recent meeting at Spokane outlined the program for the convention and it is intended to procure at least two speakers of national prominence in the East to prepare papers on live topics. They have also decided to join with the Seattle section of the American Institute of Electrical Engineers and by judicious publicity are trying to induce all electrical men who are coming to the exposition to plan their trip for that date.

The Association will have commodious headquarters in the Manufacturers' Building at the fair which will be kept open during the entire period of the fair. These rooms will be used primarily as the headquarters and resting room for all electrical men who visit the fair and the Association plans to have complete sets of views showing the various plants, power stations, etc., of all the member companies, together with data in pamphlet form concerning their development, business, etc.

BOOK REVIEWS.

"High Tension Underground Electric Cables," by Henry Floy, M. A. M. E, 135 pages, size 5x7½ inches, with numerous tables and diagrams. Electrical Publishing Company, 165 Broadway, New York, and Technical Book Shop, San Francisco. Price, $2.00.

This book is a record of experience gained in the design and equipment of several important underground installations for high-tension work. The author is well qualified to write on the subject of high-tension sub-surface transmission, and his statements are of value to all those concerned with putting wires underground. The advantages of this type of construction are detailed and numerous examples of its successful operation quoted. The latter includes several 25,000 volt installations. A full description is given of the various insulating materials, including an account of their manufacture, their faults, their good points, specifications and tests. Recognizing the unsatisfactoriness of the usual empirical formulae for determining the proper insulating thickness of wire, the author has compiled a number of tables giving this data for several materials at various voltages. Curves, tables and data are presented relative to the heating and testing of cables, as well as formula to be used in electrical calculations. The book concludes with a chapter on the costs of underground installations with practical reference to the price of cables. The author states that it is fair to assume that cable manufacturers can furnish and guarantee three-conductor cables as large as 0000 B. & S. for tensions as high as 35,000 volts. It is unusual to find a book embodying the results of so much practical experience, and for this reason it is of value to the man who is doing such work.

"Electric Lamps," by Maurice Solomon, 319 pages, size 5½x8 inches; 112 diagrams. D Van Nostrand Company, 23 Murray street, New York, and Technical Book Shop, San Francisco. Price, $2.00.

This volume brings into compact form information regarding various kinds of incandescent and arc lamps. The author's practical experience in the manufacture of several types is evinced by the publication of matter not found in the usual catalogues. A discussion of the principles of artificial illumination and a theoretical treatment of the production of artificial light precedes the chapter of photometry and methods of testing, the latter being particularly complete. Next the author takes up carbon-filament lamps and metallic filament lamps, giving in each case a historical summary of the method of manufacture, physical characteristics and life. The section devoted to the electric arc is equally complete. Under miscellaneous lamps are described the magnetite arc, the mercury vapor lamp and the Moore vapor lamp. The concluding chapter is devoted to a comparison of lamps of different types. The author's comparisons and criticisms seem fair and unprejudiced and are of material assistance in deciding what type of lamp is best fitted for any practical requirement.

"The Theory of Electric Cables and Networks," by Alexander Russell, M. A., D Sc.; 265 pages, 5x8½ inches, 71 diagrams. D. Van Nostrand Company, 23 Murray street, New York, and Technical Book Shop, San Francisco. Price, $3.00.

Mr. Russell is the author of "A Treatise on the Theory of Alternating Currents," is a member of the Council of the Physical Society and of the Institution of Electrical Engineers. He has contributed many valuable papers on the theory of electrical conductors and in this volume brings into compact form much interesting material. After a general explanation of fundamental electrical principles and a description of the various gauges in use for specifying wire, the book may be broadly divided into two subjects, treating respectively of conductivity and insulavity. The use of this latter expression is not recognized by the usual dictionary, but as it includes the subject of insulating material for both high and low tension cables, it seems justified. These main divisions are further sub-divided into low and high tension requirements. In the second chapter special attention is given to the effect of the "lay" on the weight and conductivity of stranded cables. Much space is given to the design of distributing net works. Formulae are developed for calculating not only the current transmitted, but also the insulation necessary. The author makes an excellent distinction between the requirements of low tension cables, that the insulation be such as offers the greatest resistance to the flow of electricity, and for high tension work that the insulation offers a resistance to the disruptive discharge. Consequently the wrappings suitable for low tension cables may not be suitable for high tension, and vice-versa. The text contains valuable theoretical discussion on dielectrics, from which the author deduces a number of physical constants. Further chapters deal with grading and heating of cables. In conclusion he illustrates and describes a few types of lightning arresters. The text is essentially a mathematical treatment, illustrated by numerous practical examples. It has been written more particularly in accordance with the requirements of English practice and refers constantly to the wiring rules of the English Institution of Electrical Engineers and the Board of Trade. These differ in some few particulars from the standard established by the Board of Fire Underwriters in this country, but the difference is so trifling as to make but little difference in its use here. The lack of a comprehensive summing up of formulae is partly obviated by the excellent index and convenient system of paragraph captions. It will prove of little use to the ordinary electrical contractor, but to engineers interested in insulation of high tension cables it should be invaluable.

ANNUAL MEETING OF THE ELECTRICAL TRADES ASSOCIATION.

The annual meeting of the Pacific Coast branch of the Electrical Trades Association was held at the Hotel Argonaut, San Francisco, on Saturday, April 17th.

Forty members and guests enjoyed an admirable luncheon followed by some brief speeches, the annual reports submitted by the retiring officers, and the election of new officers for the ensuing year

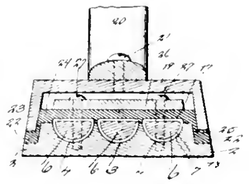
H. F. Frosch, president of the Electrical Club of San Francisco spoke briefly of the advantages of such a club and reviewed its past history. E. M. Scribner of the Journal of Electricity talked on the subject of the press and called attention to some of the existing conditions in journalism which might offer an opportunity for some reform work on the part of the electrical trades generally. W. H. Hanscom of the Century Electric Construction Company of San Francisco read a very interesting paper relative to the relation of the Trades Association to the electrical construction business. He submitted for inspection a number of old time devices collected by him during the past few years which were remarkable as an example of what electrical material should not be.

Frederic P. Vose of Chicago, National Secretary of the Association, spoke in detail of the work the Association has done in the past and congratulated the Pacific Coast branch on the good work which has been done in this section. The information given by him, based upon his national experience in this work was of unusual interest.

The following officers were elected for the ensuing year: President, A. E. Drendell of the Drendell Electric & Manufacturing Company, San Francisco; vice-president, R. F. Behan of the San Francisco office of the Westinghouse Electric & Manufacturing Company; executive committee, John R. Cole of the John R Cole Company; C. C. Hillis of the Electric Appliance Company; Samuel H. Taylor of the Electric Railway & Manufacturers' Supply Company.

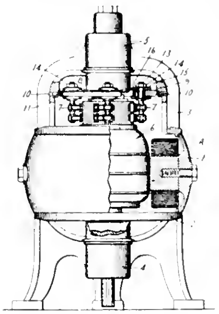
PATENTS

916,994. Electric Heater George W. Carpenter, John Rasmussen and Frederick B. McCroskey, Ontario, Cal In an electric heater, a body portion having rounded grooves in its



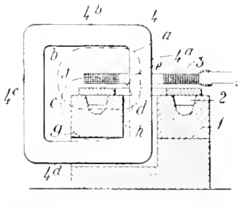
upper face, and cores disposed in said grooves, siad cores having flat upper faces and rounded under surfaces conforming to the shape of the grooves.

917,005. Brush Support for Dynamo-Electric Machines. Walter M. Coffman, Madison, Wis., assignor to Northern Electrical Manufacturing Company. In a dynamo-electric machine, a bonnet at one end thereof, a brush-supporting ring having



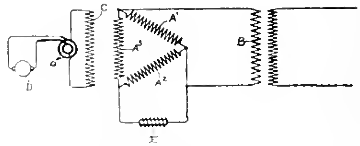
a beveled outer edge, a shoulder in said bonnet against which the outer portion of the rings bears, and a screw carried by said bonnet and engaging said beveled edge of the ring for forcing it against the shoulder.

917,040. Electric Transformer Furnace. Otto Frick, Saltsjobaden, Sweden. An electric induction furnace comprising a masonry base with an annular hearth for the material to be treated forming the secondary circuit of the furnace, a primary winding facing a horizontal side of the



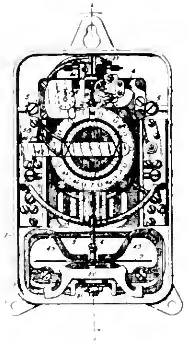
hearth, and a closed magnetic core, one limb of which is surrounded by the hearth and by the said primary winding and the other limbs of which are at such distance from the said winding that a free space is left between the iron and said winding.

917,181. Single-Phase Alternator. Charles P. Steinmetz, Schenectady, N. Y., assignor to General Electric Company. In combination with a synchronous single-phase alternator and its load-circuit, an energy storing device, and connections from the armature winding of said alternator to said device



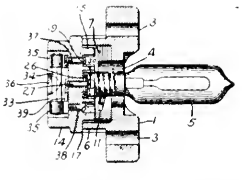
for impressing on said device a voltage displaced in phase from the terminal voltage of the alternator by an angle approximately equal to forty-five degrees plus one-half the average angle of lag in said load-circuit, said device being designed to receive a volt-ampere input approximately equal to the average volt-ampere load on said alternator.

917,130. Meter. William H. Pratt, Lynn, Mass., assignor to General Electric Company. In a meter, a spherical armature having an air core, and a pair of circular field coils each



consisting of a plurality of concentric coil sections, said field coils closely encircling the armature and mounted close together to reduce the number of stray lines of force.

917,229. Receptacle for Incandescent Lamps. Herbert C. Wirt, Schenectady, N. Y., assignor to General Electric Company. In a lamp receptacle, the combination with stationary contacts, of an insulating block having on one face lamp



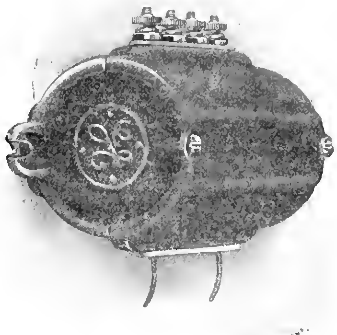
engaging terminals and contacts for engaging the stationary contacts and respectively connected to said lamp terminals, and a fuse arranged in one of the connections between terminals and contacts on said block.

INDUSTRIAL

A NEW BELL RINGING TRANSFORMER.

The electric bell and its heretofore indispensable ally, the primary battery, date back to the early days of the electrical industry. The same can be said of the alternating current transformer. But the combination of the transformer and the electric bell is of modern origin and the direct result of a desire to get rid of the troublesome and trying situations arising from the use of primary or storage batteries.

To meet this demand the General Electric Company has recently placed on the market a transformer for ringing electric bells. This transformer has a low voltage secondary winding with taps giving 6-12 and 18 volts when the primary is connected to the ordinary 110-volt lighting circuit. The transformer will operate successfully on circuits ranging from 100 to 130 volts at the usual lighting frequencies.



Materials of the highest quality are used in the construction and the design has received the same careful consideration as is given to larger transformers. Compactness, freedom from mechanical defects and absolute reliability are the resulting features.

The entire transformer is so small that it may be held in the hand. The general design has been proportioned for very low losses, the core loss being practically negligible. The transformer is designed in such a manner that a continuous short circuit on the secondary will do no damage either to the transformer or adjacent circuits.

The core and coils are placed in a small metal box with lugs or feet attached for convenience in fastening to the wall or ceiling. A screwdriver is the only tool needed for installing the transformer after which it requires no attention whatever. This is in strong contrast to the ordinary primary battery.

This transformer may also be used to advantage for operating buzzers, spark coils, burglar alarms, miniature lamps, door locks, gas lighting and annunciator systems.

GENERAL ELECTRIC EXHIBIT AT THE ALASKA-YUKON-PACIFIC EXPOSITION.

The General Electric Company's exhibit at the Alaska-Yukon-Pacific Exposition will cover a floor space of 1400 square feet in Machinery Hall and will consist mainly of various supplies, together with some larger apparatus of particular interest to that section of the country—such as mine locomotives, mine hoist equipment, electric air drills, etc.

The small material exhibit will include a display of domestic applications of small motors, arc and incandescent lighting apparatus and supplies, heating devices, oil switches, circuit breakers, rectifiers and other devices of general interest.

The booth will be given a charming Dutch treatment throughout and will, in addition to open floor space for the heavier material, consist of two rooms, one of which will be used for the complete display and demonstration purposes of cooking and heating devices, and the other for a reception room.

TRADE NOTES.

The New York office of the Weston Electrical Instrument Company, Newark, N. J., will be moved from 74 Cortlandt street to 114 Liberty street, on May 1, 1909.

The San Francisco office of the Gould Storage Battery Company, now located at 705 Monadnock Building, will on May 1st be moved to the Atlas Building, 604 Mission street.

Dossert & Company of New York City, manufacturers of Dossert Solderless Connectors, announce an arrangement just completed with Otis & Squires of San Francisco under which that company will in future take care of their interests upon the Pacific Coast.

The National Battery Company of Buffalo, New York, manufacturers of storage battery equipment, announce that they have just completed an arrangement with Otis & Squires of San Francisco, under which that firm will in future look after their interests upon the Pacific Coast.

TRADE CATALOGUES.

Condulets of all kinds, shapes and sizes are illustrated and described in a large 80-page catalogue from the Crouse-Hinds Company, of Syracuse, N. Y.

Engine type direct current generators, designed for general lighting and power service are described in bulletin No. 1059 issued by Allis-Chalmers Company of Milwaukee, Wis.

John C. Dolph Company, 153 West avenue, Long Island City, New York, sends a pamphlet explaining the advantages of their "Wayahead" non-combustible insulating compound.

Catalogues 15A and 15B from The Dale Company of New York City, John R. Cole Company, San Francisco representatives, show the tungsten fixtures and wireless clusters which they are manufacturing.

The Gould Battery in Isolated Lighting Plants is the subject of an interesting bulletin from the Gould Storage Battery Company, of 341 Fifth avenue, New York City, and Atlas building, San Francisco. It contains some valuable suggestions for economy.

Pamphlet No. 3768 from the General Electric Company, contains a comprehensive list of motor starting and speed controlling devices, both automatic and non-automatic starters. Each device is illustrated and briefly described, and the pamphlet will be of value to all interested in any way with motor drive.

A handsome publication devoted to the Curtis steam turbine-generator has recently been issued by the General Electric Company under the number 4653. This bulletin is quite elaborate so far as details of construction are concerned, containing interior views and cross-sections of various parts of turbine and generator. It describes large and small turbines of vertical and horizontal types, and contains illustrations of numerous representative Curtis turbine installations.

NEWS NOTES

FINANCIAL.

MONROVIA, CAL.—A bond election will be held in this city on June 7th to vote on the issuance of bonds for municipal improvements.

SAN FRANCISCO, CAL.—The Olympic Salt Water Company has levied an assessment of $1 per share on the capital stock of the company.

SAN FRANCISCO, CAL.—President W. B. Morris of the Western Iron Works has advertised the sale of $10,000 face value of 6 per cent bonds of the Olympia Gas & Power Company.

LOS ANGELES, CAL.—G. Watson French has filed two suits against the Paso Robles Light & Power Company, which involve 75 per cent of the capital stock of the company, valued at $45,000.

PALO ALTO, CAL.—A bond election will be held in this city on May 10th, to decide on the issuance of $16,000 in bonds for a waterworks building, $7,000 for a new water tank, $5,000 for a steel roof for the waterworks, $3,500 for a street lighting system, and $25,500 on other improvements.

INCORPORATIOINS.

BAKERSFIELD, CAL.—The Robertson Oil Company has been incorporated here with a capital stock of $75,000.

RENO, NEV.—The Lander County Power & Light Company has been incorporated here with a capital stock of $200,000.

SAN LUIS OBISPO, CAL.—The Adelaide Rural Telephone Company has been incorporated here by Otto Wyss, A. Dubost, W. I. Davis, H. C. Sutton and John Joaquin.

SAN FRANCISCO, CAL.—The S. & T. Oil Company has been incorporated here with a capital stock of $800,000 by W. G. Henshaw, V. Eingineer, J. C. Kemp, F. L. Brown and A. Raymond.

BAKERSFIELD, CAL.—The Uncas Oil Company has been incorporated here with a capital stock of $500,000 by Burke Corbet, Irving Peterson, J. R. Selby, J. M. Wilson and E. V. Whitaker.

TRANSMISSION.

HOLLISTER, CAL.—Bids will be received by the Board of Supervisors till May 17th, 1909, for an electric power franchise in this city.

RHYOLITE, NEV.—The Springdale Water & Power Company has applied for a franchise to construct an electric power plant in this city.

RED BLUFF, CAL.—Smith Crowder has filed notice of appropriating 12,000 inches of water on Mill creek for electric power purposes.

SANTA BARBARA, CAL.—Bids will be received by the City Council up till May 6th, 1909, for an electric franchise to erect power distributing systems in this city.

OROVILLE, CAL.—The Sierra Electric & Power Company has been granted a franchise to erect power distributing lines on the public roads and highways of Butte County.

BUTTE, MONT.—The Great Falls Water Power & Townsite Company has applied for a right of way for a double steel tower transmission line from Butte to Great Falls.

EUREKA, CAL.—J. N. Lenteel has located four water-rights for power purposes in this vicinity. The largest location was 20,000 inches on the Mad river about 200 feet below the mouth of Bug creek.

CORNING, CAL.—The North Electric Power Company will increase the capacity of its plant from 2000 horse-power to 60,000 horse-power, owing to the increased demand for electric power in this vicinity.

CHIHUAHUA, MEX.—M. J. O'Brien and A. P. Bronn are planning to build a 500 horse-power hydro-electric plant on Morris river. The power will be used to operate mines which are located in this vicinity.

SPOKANE, WASH.—The Washington Water Power Company this fall will start the installation of four 13,000 horse-power turbines on Middle Island in the Spokane river. The work will be in charge of C. S. MacCalla.

GEORGETOWN, CAL.—G. E. Williams and Martin Costello have filed notice of the appropriation of 400 inches of the water flowing into North Otter creek. The water power is to be utilized in generating electric power for use in the mines.

EL PASO, TEX.—C. W. Webster of the Stone-Webster Company, states that plans are under way for making extensive improvements to the present power plant, which will cost $300,000. A 2250 horse-power steam turbine engine with auxiliaries, pumps and condensers will be installed.

SPOKANE, WASH.—The Northern Idaho & Montana Power Company has been organized with a capital stock of $6,500,000, and an authorized bond issue of $10,000,000, to operate electrical properties in eastern Washington, northern Idaho and western Montana. It now controls water powers capable of developing over 100,000 horsepower at minimum flow on the Big Fork River, Moyie River and Pend o'Reille River. Plants are operated at Newport, Wash.; Sand Point, Idaho; Polson, Mont., and Kalispell, Mont. The company was promoted and financed by H. M. Byllesby & Company, engineers, and Howard, Simmons & Company, bankers, of Chicago.

ILLUMINATION.

TOMBSTONE, ARIZ.—C. L. Cummings has been granted a franchise to construct an electric lighting system in this city.

UPLANDS, CAL.—Bids will be received by the Board of Trustees till May 10th, 1909, for a fifty-year gas franchise in this city.

AZUSA, CAL.—The Covina Valley Gas Company, which recently bought out the Covina Gas Company, has asked for a franchise at this place.

OGDEN, UTAH.—Manager Danville Decker of the Utah Light & Railway Company, states that the company is to begin immediate work on enlarging the gas plant.

DOWNEY, CAL.—J. R. Gordan, owner of the electric light plant at Downey and County Farm, will extend the lines to Rivera, Norwalk and Artesia at an early day.

LOS ANGELES, CAL.—The City Council has decided to purchase the appliances needed to install the electric lighting system for Fifth street, between Main and Central avenue.

LEMOORE, CAL.—A committee has been appointed by the Trustees to secure figures from President Wishon of the San Joaquin Light & Power Company for furnishing this city with street lights.

TELEPHONE AND TELEGRAPH.

BAKERSFIELD, CAL.—The Kern Mutual Telephone Company has applied for a telephone franchise in this city.

UKIAH, CAL.—Carl Purdy and those represented by him have been granted a franchise to erect poles for a private telephone line along the public highway from the race track to Figoni's ranch.

PALA ALTO, CAL.—The Pacific Telephone & Telegraph Company, which recently spent $75,000 in improving its telephone plant here, has issued orders for further improvements to be made at an expense of several thousand dollars. The overhead wires on University avenue are to be placed in an underground conduit as far out as Waverly street.

TRANSPORTATION.

BLAINE, WASH.—Work is to be started this spring on the Nooksack Valley Traction line between Bellingham and Blaine.

ILWACO, ORE.—The Ilwaco Electric railway has a franchise to operate over the county roads between Ilwaco and Stackpole.

COEUR d'ALENE, IDAHO.—The Spokane & Inland Electric railway contemplates an extension from Coeur d'Alene to Wallace, Idaho.

LEWISTON, IDAHO.—M. A. Means of the Lewiston Terminal Company has been granted a franchise for a street car line in Lewiston.

RENTON, WASH.—E. L. Blaine has applied for permission to construct a double track electric railway along the county road between Renton and Issaquah.

SACRAMENTO, CAL.—The California Traction Company has been granted a franchise to construct electric lines on certain desired rights of way in this city.

SAN RAFAEL, CAL.—E. B. Martinelli has asked for a franchise to construct an electric road from Manzanita station up the canyon a distance of three miles.

SEATTLE, WASH.—The Seattle, Snoqualmie & Everett railway has applied for a street railway franchise along certain streets in the Exposition Heights addition to the City of Seattle.

BERKELEY, CAL.—Work began last week on the electrification of the Southern Pacific Company's interurban lines in this city, the construction of which it is stated will involve some $3,000,000. Assistant Engineer Edward G. Miller is in charge of the work.

OAKLAND, CAL.—Promoters of the Oakland & Antioch Electric Railway have succeeded, it is stated, in financing the project. Surveys for the road have been made. The projected route is across Contra Costa county. Among those promoting the company are J. Napthaly, A. W. Maltby and Allan Pollok.

PORTLAND, ORE.—The Oregon Light and Power Company has been organized by H. H. Riddell, A. E. Murphy and N. L. Bailey, all of Portland, with a capital of $2,000,000, to furnish electric light and power to Portland and the surrounding district. The plant may be ready for operation within eighteen months.

FRESNO, CAL.—Surveys have been made and capital is being secured for the construction of the proposed Fresno, Hanford & Summit Lake Interurban Railway. Construction contracts will be let as soon as bonds are placed. The projected length of this line is 40 miles, and it is to extend from Fresno to Hanford via Fowler, Selma, Kingsburg and Laton. F. S. Granger, Fresno, Cal., is general manager. Chadwick & Sykes, Crocker Building, San Francisco, Cal., are the engineers.

NAPA, CAL.—The Vallejo, Benicia & Napa Valley Railroad Company at its annual meeting held last week decided to reduce the number of directors from seven to three. The following directors were chosen for the ensuing year: President, W. T. Botsfore; vice president, Dr. E. Z. Hennessey; secretary, John T. York.

MONTEREY, CAL.—Preliminary surveys have been made for the construction of an electric railway from Monterey to Del Monte Heights. Construction work is to be started very soon. The estimated cost of the line is $35,000 and it is to be built for the Del Monte Townsite Company, room 702 Pacific Building, San Francisco, Cal.

SPOKANE, WASH.—Official announcement is made by Colonel Albert M. Dewey of Spokane, president of the Okanogan Electric Railway Company that French capitalists have taken over a bond issue of $3,000,000, the money from which will be used to build a line from Nighthawk, in north central Washington, to a point near the head of navigation on the Columbia river, 75 miles affording communication with the outside for a rich lumber, mineral and agricultural district not now served by a railroad. The road will also be extended east to Spokane and west to Seattle, making a system of more than 500 miles, for the construction and equipping of which Colonel Dewey says ample capital has been secured, adding: "We have had engineers in the field several months, running preliminary surveys for an electric railway from Spokane to Seattle and are now looking for a feasible pass through the Cascade mountains near the west fork of the upper Methow river. I have interested capitalists in the line, and if we can find the right pass we shall build by way of Bridgeport and the Methow Valley and down the Skagit river to a point which will give us a connection with the Great Northern railway at Rockport, going thence into the Sound cities. We have a 50 year franchise, right of way and charter. The line will pass through Loomis, Okanogan, Ophil, Malott, Brewster and Riverside. It will connect at the north end with Victoria, Vancouver & Eastern extension of the Great Northern railway, thus giving us Spokane connection on the east and the Sound cities on the west. We want direct communication with Seattle and Spokane and we are now running a line of survey to secure a feasible route with that end in view."

WATER.

ONTARIO, CAL.—C. A. Greenleaf has asked for a franchise to lay water pipe lines from this city to the Ocean View Tract.

LONG BEACH, CAL.—The Long Beach Water Company will move its water mains from American avenue to a private right of way in the near future. The undertaking is estimated to cost $25,000.

LARKSPUR, CAL.—The Wright Water Company has been leased for three years by Messrs. LeCornec & Larkins of that place. These gentlemen propose to increase the storage capacity of the plant as well as increase facilities for better service.

CHICO, CAL.—In order to overcome the loss of water by seepage in the ditch system of irrigation, an extensive underground pipe irrigation system is being installed at the National Plant Introduction Gardens here. In addition a 20,000 gallon tank will be stationed in the gardens to afford an ample supply of water.

SAN DIEGO, CAL.—The following bids were received by the Board of Public Works for furnishing this city with 500 lengths of 10-inch water pipe: The Western Metal Supply Company, 33.50 cents per pound; J. B. Clow & Sons, 35.50 cents per pound; Hazard, Gould & Co., 33.98 cents per pound; Christian, Froleck & Co., 33.80 cents per pound; United States Pipe Company, 33.40 cents per pound.

BAKERSFIELD, CAL.—F. T. Torpey has been granted a franchise to lay down water pipes from the Ruby Oil Company to Maricopa, to supply the inhabitants of that town.

SAN FRANCISCO, CAL.—At the annual meeting of the Spring Valley Water Company held this week it was decided to increase the number of directors from seven to eleven and an executive board, consisting of William B. Bourn, Captain Payson and Antone Borel, was created. The new directors are: President, W. B. Bourn; vice president, A. H. Payson; second vice president, S. P. Eastman; W. B. Bourn, A. H. Payson and Antone Borel, executive committee; directors, former members, W. B. Bourn, A. H. Payson, F. B. Anderson, Antone Borel, I. W. Hellman Jr., Homer W. King and J. M. Quay; new members, S. P. Eastman, T. B. Berry, E. L. Eyre, Osgood Hooker, E. J. McCutchen and Louis F. Monteagle.

OIL.

POINT RICHMOND, CAL.—A 500,000 barrel oil tank exploded here last week, injuring several people and causing a loss by fire of $100,000.

SAN FRANCISCO, CAL.—The Muscatine Oil Company will hold a meeting on June 14th to consider increasing the capital stock of the company.

BAKERSFIELD, CAL.—The annual statement of the Standard Oil Company shows a decrease of oil in store on March 1st of nearly 150,000 barrels, compared with the figures for the preceding year, being 10,038,852, as against 10,171,662 on March 1, 1908.

COALINGA, CAL.—At a meeting of the Coalinga Independent Oil Producers Agency the following directors were chosen: President, Stanley W. Morsehead; vice president, Thomas O'Donnel; second vice president, M. V. McQuigg; treasurer, H. H. Welch; secretary, R. V. Dallas.

SAN FRANCISCO, CAL.—Messrs. Smith & Byrnes, who were interested in the Seven Oil Company, have acquired some 8,000 acres in the Kreyenhagen District, about 15 miles south of Coalinga. They are now busy cleaning the abandoned wells on the Black Mountain and Black Hills properties and will endeavor to get their fuel from them.

The oil industry of California is enjoying a splendid prosperity at the present time; there is an increasing interest and activity; and investors are being attracted to the fields by virtue of the nice profits which are being made by California oil companies. The chief factors in the present movement are increasing disbursements by the listed oil companies; an increasing production of crude oil, with the demand greater than the supply of the fields, and a good price prevailing for the product.

SAN FRANCISCO, CAL.—Several important oil representatives have made statements to the effect that unless efforts are made to stop increasing the production of oil in this State prices will fall considerably. These men have recommended a suspension of all development, except such as may be necessary to protect lines or to comply with lease requirements. The output is now estimated at 10,000 barrels a day in excess of consumption and within the last 70 days the Associated Oil Company has placed in storage 728,000 barrels in the Kern River field. The yield daily is 151,000 barrels; the consumption is 142,000 barrels. At the present ratio of increase the production will be 20,000 barrels in excess of consumption by the end of the year.

SAN FRANCISCO, CAL.—In 1908 California produced over 5,000,000 barrels more than the record for 1907. There seems but little question that this year will show still greater gains, by reason of the large number of new companies which are entering the field, and which are bringing in new producers. It is likely that the output for 1909 will top the 50,000,000-barrel mark. The principal producer is Kern county, with the Kern River district leading. Next in order is the Sunset field; then, in turn, the Midway and the McKittrick. Over 300 new wells were drilled in 1908, and a larger number will be recorded for the present year. Of the forty odd listed oil companies, nearly thirty are now making regular disbursements. The dividends for March, paid by the listed companies alone, amounted to $450,000; bringing their grand total almost to the $20,000,000 mark. And to this, of course, must be added the dividends of the companies not listed on the exchange, as well as the profits made by private owners. Fuel is at a premium on the Pacific Coast, and oil has been in steadily increasing demand for fuel purposes in many lines of industrial undertaking. A big customer is the railroad interests, all the various systems looking to this fuel for operating purposes. Oil is cheaper than coal, and oil becomes a necessity, by reason of the inadequacy of the supply of coal from the Pacific Coast. The Orient constitutes another big customer for California oil, and frequently has had to carry oil from sections farther away, because of the inability of this field to meet the demand. More uses, and relatively increasing demand for California oil, holds up the market; and in keeping therewith the opening of new producers in various sections is stimulating activity in oil well operation.

SPRING MEETING OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

The American Society of Mechanical Engineers will hold its spring meeting in Washington, D. C., May 4-7. Professional sessions will be held at which papers on the conveying of materials, gas power, engineering, steam turbines, the specific volume of saturated steam, oil well pumping and various other subjects will be discussed.

At the reception, which will be held in the New Willard hotel, an address of welcome will be made by the Hon. B. F. Macfarland, president of the Board of District Commissioners, with a response by Mr. Jesse M. Smith, president of the society.

During the convention President Taft will hold a reception for the members at the White House. The War Department will give a special exhibition drill of the U. S. troops at Fort Myer, to which the members and guests will be invited. At the same time, if the conditions are favorable, an ascension of a dirigible balloon will be made and probably also that of an aeroplane.

An address will be given by Rear-Admiral Melville, retired, past president of the society, and former engineer-in-chief of the navy, the subject being "The Engineer in the Navy." This evening will be made the occasion for the presentation to the national gallery of a portrait of Rear-Admiral Melville presented by friends and admirers. It will be received for the national gallery by Dr. C. D. Walcott, secretary of the Smithsonian Institution.

F. H. Newell, director of the Reclamation Service, will deliver an illustrated address on "Home Making in the Arid Regions." Trips will be made to various points of interest about the city and a number of pleasurable excursions have been planned.

The papers to be presented are as follows:

A Unique Belt Conveyor, Ellis C. Soper; Automatic Feeders for Handling Material in Bulk, C. Kemble Baldwin; A New Transmission Dynamometer, Prof. William H. Kenerson; Polishing Metals for Examination with the Microscope, A Kingsbury; Marine Producer Gas Power, C. L. Straub; Operating System for a Small Producer Gas Power Plant, C. W. Obert; A Method of Improving the Efficiency of Gas Engines, T. E. Butterfield; Offsetting Cylinders in Single-Acting Engines, Prof. T. M. Phetteplace; Small Steam Turbines, George A. Orrok; Oil Well Tests, Edmund M. Ivens; Safety Valve Discussion; Specific Volume of Saturated Steam, Prof. C. H. Peabody; Some Properties of Steam, Prof. R. C. H. Heck; A New Departure in Flexible Staybolts, H. V. Wille.

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Classified List of Advertisers, and Material They are Prepared to Furnish.

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Sterling Elec. Co.
Western Elec. Co

ASBESTOS
Johns-Manville Co., H. W.

AUTOMOBILE ACCESSORIES
American Eveready Co., "Ever Ready."

INDEX TO ADVERTISEMENTS

BATTERIES

DRY BATTERIES
American Eveready Co., "Ever Ready" and "Crescent."
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Standard Electrical Works, "Standard."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

DRY BATTERY HOLDERS
Stanley & Patterson, Inc., "Patterson."

MEDICAL BATTERIES
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Electro-tonic," "Vetter."

OPEN AND CLOSED CIRCUIT WET BATTERY
Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

STORAGE BATTERIES
Elec. Storage Battery Co.
Westghse Machine Co.

BELLS

ELECTRIC BELLS
Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick, Carter & Wilkins Co.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

ELECTRO-MECHANICAL GONGS
Edwards & Co.
Electric Goods Mfg. Co.
Partrick, Carter & Wilkins Co.

MAGNETO BELLS
Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Sw'b'd & Supply Co.
Standard Elec. Wks., "C & S"
Western Electric Co.

BOILERS

Henshaw-Bulkley & Co.
Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, Edge Moor."

BOOKS

Technical Book Shop.

BOXES

FLOOR AND OUTLET BOXES
Krantz, H., Mfg. Co.

JUNCTION BOXES
Krantz Mfg. Co., H.

WALL BOXES
Benjamin Elec. Mfg. Co.
Bossert Electric Const. Co., "Bossert."
Chase-Shawmut Co., "Knockout."
Chicago Fuse Wire & Mfg. Co., "Union."
Cutter Co., The, "Munit."
Elec. Appliance Co., "T & B"
General Electric Co.
Krantz, Mfg. Co., H.
Paiste, H. T. Co.
Pass & Seymour.
Sprague Electric Co., "Universal."
Standard Elect'l Wks., "M & M."
Stanley & Patterson, Inc., "Simplex."

BRACKETS

CEILING BRACKET AND DESK FIXTURES
Stanley & Patterson, Inc., "Sunlight."

DESK TELEPHONE BRACKETS
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Electric Appliance Co., "Paranite."
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Kierulff, B. F., Jr. & Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
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Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."
PAPER INSULATION
Belden Manufacturing Co.
Western Electric Co.
TELEPHONE CABLE
Dean Electric Co.
Kellogg Sw'b'd & Supply Co.
Kellogg, W. E. Co.

CARBONS
ARC LIGHT CARBONS
Brooks-Follis Elec. Corp'n, The, "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS
Cutter Co., The, "I-T-E." "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
Kierulff, Jr., & Co., B. F. "Hartman."
Pacific Electric & Manufacturing Co.
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLAMPS
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Belden Manufacturing Co.
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Chase-Shawmut Co., "Shawmut."
General Electric Co.
Paiste Co., H. T., "Perma-Effect"

CLEATS
FIBRE CLEATS
Blake Signal & Mfg. Co.
PORCELAIN CLEATS
General Electric Co.
Pass & Seymour
Standard Electrical Works, "Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Elec. Co., H. D. Sears, general sales agent.
Western Elec. Co., "Thomas"

COILS
ARMATURE AND FIELD COILS
Belden Manufacturing Co.
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Western Electric Co., "Deltabeston."
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Electric Goods Mfg. Co.
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SPARK COILS
Electric Goods Mfg. Co.
Western Electric Co.

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BOILER COMPOUNDS
Dearborn Drug & Chemical Works.
Johns-Manville Co., H. W., "Magic."

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FLEXIBLE CONDUIT
American Circular Loom Co., "Circular Loom."
Sprague Electric Co., "Greenfield."
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American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct," "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roeblings Sons Co., J. A. "Navalite."
Sprague Electric Co., "Iron Armored."
UNDERGROUND CONDUIT
American Cross Arm Co., "Walworth & Neville."
Johns-Manville Co., H. W., "J.-M."
Pierson, Roeding & Co., "Fibre."
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American Eveready Co., "Bulldog."
Belden Manufacturing Co.
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F., Jr. & Co.

CORD
FLEXIBLE BELL CORD
Belden Manufacturing Co.
General Electric Co.
Kierulff, B. F. Jr. & Co., "National."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roebling Sons Co., John A.
Simplex Elec. Co.
Western Electric Co.
LAMP CORD
Belden Mfg. Co.
Elec. Appliance Co., "Paranite."
General Electric Co.
Okonite Co., The, "Okonite."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Roeblings Sons Co., John A.
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Standard Und. Cable Co.
Western Elec. Co., "Victor."
TELEPHONE CORD
Belden Manufacturing Co.
Dean Electric Co.
Kellogg Sw'b'd & Supply Co
Kierulff, B. F., Jr. & Co. "National."
Pierson, Roeding & Co., Agts. Elec. Cable Co.
Safety Ins. Wire & Cable Co.
Simplex Elec. Co.
Western Elec. Co., "Victor."

CROSS ARM BRACES
Benicia Iron Works.
Kierulff, B. F., Jr. & Co.
WOOD KNOBS
Blake Signal & Mfg. Co.

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FIXTURE CLUSTERS
Benjamin Electric Mfg. Co., "Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbell."

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Bryant Electric Co.
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General Electric Co.
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Paiste Co., H. T., "Shaffer," "K. W.," "P. K." "Taplets."
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ELECTRIC NOVELTIES
American Eveready Co "Ever Ready."

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GAS AND GASOLINE ENGINES
Moore & Co., Chas. C.
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Hunt, Mirk & Co., "Westinghouse."
Kierulff, B. F., Jr. & Co "American Diesel Engine
Tracy Engineering Co.
Westghse Machine Co.
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Standard Engineering Co "Engberg."
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Westghse Elec. & Mfg. Co.
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Sprague Electric Co., "Lundell."
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Western Electric Co., "Hawthorne."
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Western Elec. Co., "Victor "Emerson."
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Electric Appliance Co., "Colonial."
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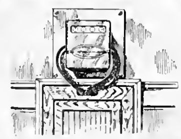

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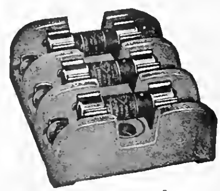

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ON LIGHTNING PROTECTION.[1]

BY A. G. JONES.

The history of lightning protection in the electrical field began with telegraph circuits. A careful analysis was made of these conditions and experimental demonstrations were given by Sir Oliver Lodge in England. The problem was comparatively simple. On the telegraph circuits the potential employed and the amount of energy in their batteries were too small to cause or maintain an arc from line to line or from line to ground. Lightning was taken from these lines by the insertion of a small gap in the wire leading from each line to the earth. This simple lightning arrester could be designed without any consideration of the natural frequencies of the lightning, duration of the lightning stroke, the potential of the electrical generator or the amount of energy that might be concentrated in the lightning arrester during the discharge.

Before entering into a general discussion of the principal types of lightning arresters, it will not be amiss to explain more definitely the meaning of the word "lightning," as it is applied at the present time. Formerly the word "lightning" was used to denote atmospheric electrical disturbances only, but with the advent of high voltage transmission systems, the word has been used in a broader sense, and is now generally accepted as denoting all phenomena due to abnormal voltages and abnormal frequencies which may be caused from one or a combination of several different sources.

Direct Lightning Stroke to Ground, Tonopah, Nevada.

[1]Paper read before San Francisco Section of the American Institute of Electrical Engineers, March 26, 1909.

In general, abnormal [illegible] may be subdivided into three general classes:

1. Steady [illegible] or gradual charge.
2. Impulse or traveling wave.
3. Standing wave or oscillation.

Steady [illegible] or gradual charge may be caused [illegible] being driven across the transmission lines by high wind from a passing cloud which may be charged to a very high potential above earth, by line traversing territory of widely varying altitude.

The impulse or traveling wave is due to a direct stroke of atmospheric lightning, to the inductive effect of a discharge from cloud to cloud or from cloud to earth, to arcing grounds, which are very common, and to sudden changes of load, switching, etc.

The standing wave of oscillation may be of most any frequency, the high frequency usually giving rise to the lower frequencies which cause surges that represent the generated power of the circuit, the frequency of which is usually in the neighborhood of the fundamental or natural frequency of the system. This oscillating power is represented by two components, one being the electro-magnetic energy which is equal to the product of one half the inductance of the circuit times the square of the instantaneous value of the current, the other being the electrostatic energy which is equal to one half the capacity times the square of the instantaneous voltage. [illegible] electro-magnetic energy which [illegible] most [illegible] the [illegible] the instantaneous value of the current.

[illegible]

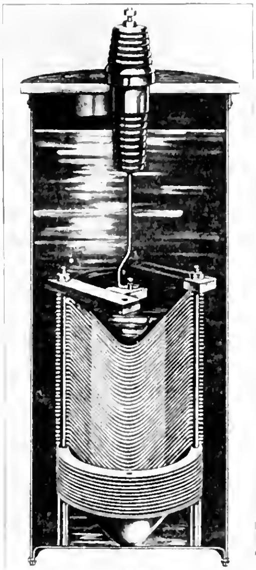
[illegible] the molten metal from [illegible] and thus put the arrester permanently out of operation. Different electrical companies differed in their practice about this time. One year one company advocated the use of the arrester without [illegible] and another company talked of the advantages of the [illegible] series resistance. The next year the two companies would reverse their policies. On the face of it the desideratum seemed to be impossible to attain. It is desired to have practically zero resistance between line and ground when the lightning discharge takes place, but a comparatively high resistance when the dynamic follows. Since potential is [illegible] of the same nature whether generated by a machine or by the clouds and both potentials occur simultaneously over the arrester, how is it possible to design an arrester so that the series resistance will always be effective in holding back the dynamic current and yet does not lie in the path of the lightning discharge.

The basic principle of the multigap arrester has been known for many years under the name of "non-arcing quality of metals." More recently it was discovered that the so-called non-arcing quality of the metal was rectifying, that is to say, if an arc was started in one direction it could be easily maintained at a comparatively low voltage, about 20 to 30 volts, but if the potential reversed it would require several thousand volts to re-establish the arc with the current in the opposite direction. During the past three years the [illegible] of lightning arresters has consisted [illegible] number of gaps in [illegible] resistance. It is evident [illegible] the lightning [illegible] in limiting the [illegible] the arc is established [illegible] the arrester. [illegible] will also limit [illegible] in other [illegible] quantity [illegible] will therefore [illegible] lightning. [illegible] heavy discharge [illegible] arresters with [illegible] satisfaction. [illegible] would [illegible] would be [illegible]

[illegible] arrester problem [illegible] developed [illegible] with a [illegible] of the [illegible] half [illegible] of [illegible] these [illegible] in [illegible] resist- [illegible] shunt, [illegible] and [illegible] ground [illegible] these [illegible] sensi- [illegible] It is a [illegible] of the

lightning the more easily will it discharge over the multi-gaps. These arresters are now in their second year with no suggestions regarding their improvements. When the multi-gap arrester begins to discharge there is a successive action of the different parts. This action is best described as "breaking back action" on low frequency surges.

In this manner the discharge of lightning can find its way to earth without passing through series resistance. On the other hand, the dynamic at generator frequency is extinguished immediately by the shunting action of the parallel resistance. The shunt resistances are so adjusted to the number of parallel gaps that nothing but high frequency discharges can be maintained across the parallel gaps.

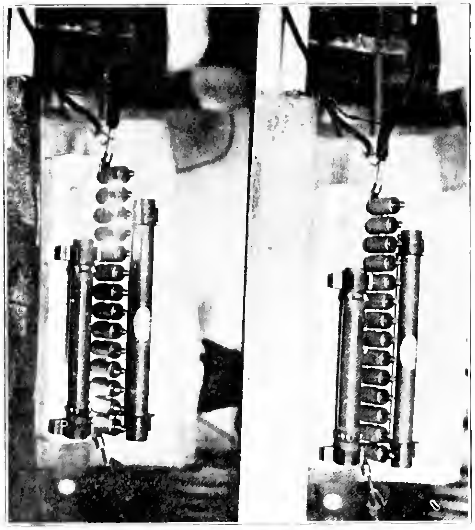


Cross Section of Single Leg Aluminum Lightning Arrester for 20,000 Volts.

The multi-gap arrester has its limitations. It is particularly useful to discharge transitory lightning such as induced by thunder clouds. Occasionally, however, an accidental arc will take place on the circuit which will cause recurrent surges at both the making and breaking of this arc.

It has developed that internal surges in a transmission system due to some accidental condition, such for example as a broken transmission wire or a wire grounded against a tree or pole, will cause abnormal rises in electric pressure on the circuit almost as high as those caused by cloud lightning and far worse to suppress because these potential rises are recurrent. It was found that the multi-gap arrester would discharge these recurrent surges, but since it is impossible to design an economical resistance for a lightning arrester which will carry the dynamic current continuously, the arrester resistances were destroyed under these particular conditions. These recurrent surges, or they may be called continual lightning, introduce a new factor in the lightning arrester problem. Research has been made for years to discover some substance which would have a property like that of a safety valve on the steam boiler. The action of the steam safety valve, as every one knows, is to relieve the pressure in the boiler as soon as it rises to a fixed value, according to the strength of the boiler. Below that value there is no discharge.

In electrical circuits it has been found through the investigation of Prof. E. E. F. Creighton, that the aluminum condenser will perform the same function to the electrical circuit that the steam safety valve does to the boiler. The aluminum cell connected between line and ground on the electrical circuit corresponds to a leaky safety valve. Under normal pressure

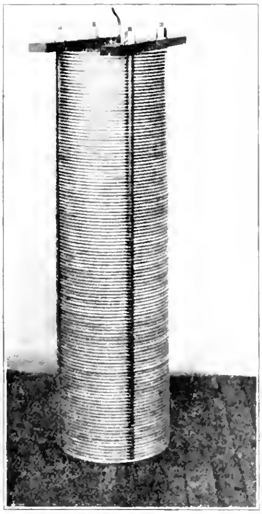


2300 Volt Arrester in Actual Operation. The upper unit is discharging high frequency current approximately of the same volume between each of the gaps, the little white dots between the cylinders indicating the arc. On the lower unit the current in the gaps shunted by the low resistance is static, while that in the remainder of the gaps is dynamic, thus indicating the flow of current of low frequency, and shows admirably the selective path employed in the design of the multigap arrester.

of the circuit there is a slight leakage of current all the time. When, however, the pressure rises to about 35 per cent above the normal generator pressure the electrical valve in the condenser opens up and allows the current to flow freely from the line to the ground, and closes up instantly when the pressure returns to its normal value. Since there is practically no discharge at normal pressure no appreciable energy is taken from the generator, but all the energy of the lightning stroke can be easily absorbed. Since this arrester can be designed to be connected between line and ground for any desired length of time, it takes care of the recurrent surges which have already been mentioned. The introduction of this lightning arrester was delayed by the natural antipathy to anything wet about the electrical station and by the long exhaustive tests required to determine the choice of electrolyte for the cell.

The aluminum cell consists of two aluminum

plates, immersed in a suitable electrolyte. On the surface of the plates is formed a film of high resistance, the film being deposited by a special electro-chemical process. This film has very peculiar characteristics, and up to a certain "critical" voltage has a very high dielectric strength. This critical voltage is subject to either of two conditions, and we may speak of the film as having a "temporary critical voltage" and a "permanent critical voltage." When a cell is connected in a circuit and the voltage gradually increased, there will be a slight flow of current due to leakage until the value of approximately 420 volts is reached, at which point the film will break down uniformly over its entire surface and allow current to flow in proportion to the impressed voltage. This value of approximately 420 volts is called the permanent critical voltage. On the other hand, suppose we have a cell which has been



Stack of Cones in 60,000 Volt Arrester.

connected to a circuit of 350 volts for a considerable length of time. The film will adjust itself so that it will allow a very slight leakage current to flow at this value. If, however, the voltage is suddenly raised to 400, there will be a momentary rush of current greatly in excess of the leakage value. The current will almost immediately die down to its normal leakage value at 400 volts. In such a case as this the value of 350 volts may be termed the temporary critical voltage.

The aluminum arrester designed for use on direct current has a discharge rate of .001 ampere at 600 volts and a discharge rate of 1100 amperes at 1200 volts. That is to say, that the discharge rate at double voltage is a million times as great as the discharge rate at normal voltage. This arrester operates without a series gap and therefore begins to discharge the instant the voltage begins to rise above normal.

On alternating current circuits of higher voltages, especially on overhead lines, the form of aluminum arrester is changed to meet the demand of these new conditions. As explained above, the critical voltage of an aluminum cell is approximately 420 volts, therefore in designing an arrester for high voltages, it is necessary to place a number of these cells in series, the number being so proportioned that the critical voltage per cell will not be exceeded. This is accomplished by forming the aluminum plates in the shape of cones which are mounted one above the other, being separated by suitable insulating spacers, and held in position by rigid braces. The electrolyte is placed in

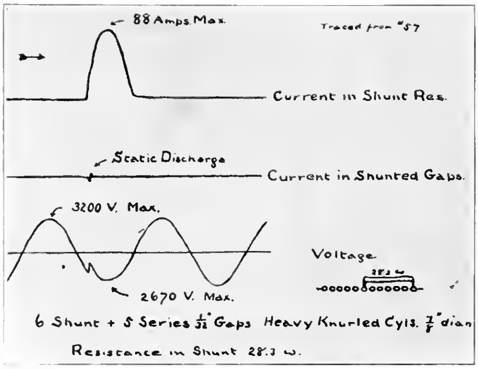
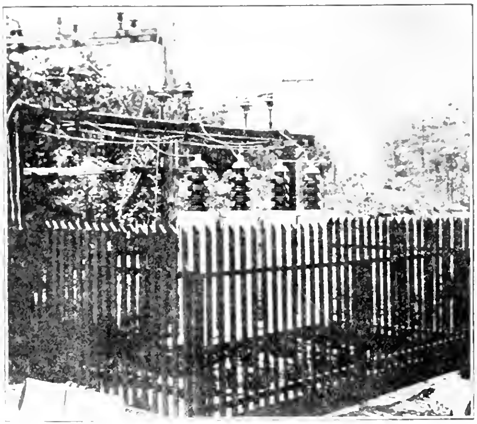


Fig. 11. Oscillogram of action in the gaps during the period of discharge.

the cells formed by the cones and an amount which will only partially fill the cells is used. The stack of cones containing the electrolyte is then immersed in a metal tank containing transil (or insulating) oil. The oil serves the purpose of rapidly absorbing the heat from the arrester during process of continual



Aluminum Cell Lightning Arrester, Out of Doors.

discharge, and it also serves as an insulator preventing arc overs from cones to tank. A gap is introduced in series and the arrester may then be made very compact. It is not designed to be continuously on the circuit, but may be put into continuous operation for a half hour or even more without destroying the arrester.

While it is possible to design these arresters to

be left continually on the circuit, it seems unnecessary under these circumstances and the extra cost of such an arrester is not justified. With the inverted concentric cones a very short path is formed between line and ground. The discharge rate is about 1000 amperes at double normal line voltage. The leakage current is about one ampere at sixty cycles. This current of one ampere does not represent energy directly, because the aluminum cell is a fairly good condenser and takes a leading current.

The horn type lightning arrester in many cases causes a great deal more damage than good, and as a protective device it is of little value. When placed directly between line and line, or line and ground without any series resistance, the chances are that when it is used on lines of medium and high k. w. capacity that it will short circuit the line when an arc-over takes place. Especially is this so in cases of recurrent discharges or "continual lightning." If resistance is used it limits the flow of discharge current and will not, therefore, give relief to the system. The flaming arc which results from a discharge of the horn arrester may last for several seconds and it is very essential that it should be suppressed at the end of the half cycle in which the discharge began. Under certain conditions the arc at the horn may cause much more damage than the original stroke. In other words, it might give rise to high power, low frequency surges. The horns have to be very carefully designed with regard to their shape, as the magnetic action probably has as much or more to do with the extinguishing of the arc as does the heat generated. If the horns themselves are imperfectly shaped the arc may travel downward instead of upward, thus causing it to hold and effectively short circuit the system.

On low potential circuits, say 2300 volts to 6600 volts, the dangers from recurrent surges are comparatively few, and therefore the multi-gap arrester is eminently suited. It is advisable, however, even on these circuits, to install in the central stations one aluminum arrester. Its gap should be set at a voltage somewhat under the sparking voltage of the multi-gap arrester, which is placed on the feeders, so that if recurrent surges take place on the line, the aluminum arrester will take the discharge. As a line arrester it is advisable to use the multi-gap type. On high voltages it is recommended that several aluminum arresters be used to take care of recurrent surges or continual lightning. Since the aluminum arrester will continue to discharge until the trouble is removed from the circuit, it should be installed as a continual lightning arrester, only in places where there is an attendant to note the discharges, or else the arrester should be equipped with a bell alarm which can be very easily and effectively applied so that it will notify an attendant at a distant point when a discharge is taking place, and steps can then be taken to locate and remove the trouble. When using the aluminum arrester as a line arrester or in unattended stations, the series gap should be placed at a sparking value equal to other transitory lightning arresters.

Regulation of telephone companies is provided by a bill introduced in the New York Legislature by Assemblyman Cuvillier. The bill prohibits telephone pools, trust agreements and combinations.

SMOKELESS COMBUSTION.

A bulletin on the smokeless combustion of coal in boiler plants with a chapter on central heating plants will soon be issued by the United States Geological Survey, Technologic Branch, giving in detail a study of the conditions found in industrial establishments in thirteen of the largest cities of Indiana, Illinois, Kentucky, Maryland, Michigan, Missouri, New York, Ohio and Pennsylvania, between 400 and 500 plants having been inspected. Sufficient information was collected to make the data from 284 plants of value for this report.

The bulletin, prepared by D. T. Randall and H. W. Weeks, not only shows that bituminous coals high in volatile matter can be burned without smoke, but also that large plants carrying loads that fluctuate widely, where boilers over banked fires must be put into service quickly and fires forced to the capacity of their units can be operated without producing smoke that is objectionable. Proper equipment, efficient labor and intelligent supervision are the necessary factors.

The burning of coal without smoke is a problem which concerns the government directly because of the advantages of smokeless combustion both in public buildings and on naval vessels. In addition, smoke abatement is a factor in conserving the fuel resources of the United States, hence, as a part of its general investigation of the best methods of utilizing the coals of this country, the United States Geological Survey has made extended tests to determine the conditions necessary for the smokeless combustion of bituminous coal in boiler plants.

The general conclusions of Messrs. Randall and Weeks are as follows:

Smoke prevention is possible. There are many types of furnaces and stokers that are operated smokelessly.

Credit is to be given to any one kind of apparatus only in so far as the manufacturers require that it shall be so set under boilers that the principles of combustion are respected. The value of this requirement to the average purchaser lies in the fact that he is thus reasonably certain of good installation. A good stoker or furnace poorly set is of less value than a poor stoker or furnace well set. Good installation of furnace equipment is necessary for smoke prevention.

Stokers or furnaces must be set so that combustion will be complete before the gases strike the heating surface of the boiler. When partly burned gases at a temperature of, say, 2500° F., strike the tubes of a boiler at, say, 350° F., combustion is necessarily hindered and may be entirely arrested. The length of time required for the gases to pass from the coal to the heating surface probably averages considerably less than one second, a fact which shows that the gases and air must be intimately mixed when large volumes of gas are distilled, as at times of hand firing, or the gas must be distilled uniformly, as in a mechanical stoker. By adding mixing structures to a mechanical stoker equipment both the amount of air required for combustion and the distance from the grates to the heating surface may be reduced for the same capacity developed. The necessary air supply can also be reduced by increasing the rate of combustion.

No one type of stoker is equally valuable for burning all kinds of coal. The plant which has an equipment properly designed to burn the cheapest coal available will evaporate water at the least cost.

Although hand-fired furnaces can be operated without objectionable smoke, the fireman is so variable a factor that the ultimate solution of the problem depends on the mechanical stoker—in other words, the personal element must be eliminated. There is no hand-fired furnace from which, under average conditions, as good results can be obtained as from many different patterns of mechanical stoker; and of two equipments the one which will require the less attention from the fireman gives the better results. The most economical hand-fired plants are those that approach most nearly to the continuous feed of the mechanical stoker.

The small plant is no longer dependent on hand-fired furnaces, as certain types of mechanical stokers can be installed under a guaranty of high economy, with reduction of labor for the fireman.

In short, smoke prevention is both possible and economical.

During 1904 to 1906 coals from all parts of the United States were burned at the Government Fuel Testing Plant at St. Louis, in furnaces which were in the main of the same design. Most of the tests were made on a hand-fired furnace under a Heine water-tube boiler. The lower row of tubes of the boiler supported a tile roof for the furnace, giving the gas from the coal a travel of about twelve feet before coming into contact with the boiler surface. This furnace is more favorable to complete combustion than those installed in the average plant. A number of coals were burned in this furnace with little or no smoke, but many coals could not be burned without making smoke that would violate a reasonable city ordinance when the boiler was run at or above its normal rated capacity.

In 1907, the steaming section of the St. Louis plant was moved to Norfolk, Va., where subsequent tests of this nature were made. The plant at Norfolk was equipped with two furnaces one fired by hand and the other by a mechanical stoker.

In the course of the steaming tests some special smoke tests were made and the influence of various features in smoke production was noted. As the tests were made as far as possible under standard conditions with a minimum variation in boiler room labor the results bring out the importance of other factors such as character of fuel and furnace design.

A brief summary of the general conclusions is as follows:

A well-designed and operated furnace will burn many coals without smoke up to a certain number of pounds per hour, the rate varying with different coals, depending on their chemical composition. If more than this amount is burned, the efficiency will decrease and smoke will be made, owing to the lack of furnace capacity to supply air and mix gases.

High volatile matter in the coal gives low efficiency and vice versa. The highest efficiency was obtained when the furnace was run at low capacity. When the furnace was forced the efficiency decreased.

With a hand-fired furnace the best results were obtained when firing was done most frequently, with the smallest charge.

Small sizes of coal burned with less smoke than large sizes, but developed lower capacities.

Peat, lignite and sub-bituminous coal burned readily in the type of tile-roofed furnace used and developed the rated capacity with practically no smoke.

Coals which smoked badly gave efficiencies 3 to 5 per cent lower than the coals burning with little smoke.

Briquets were found to be an excellent form for using slack coal in a hand-fired plant. They can be burned at a fairly rapid rate of combustion with good efficiency and with practically no smoke. High-volatile coals are perhaps as valuable when briquetted as low-volatile coals.

A comparison of tests on the same coal washed and unwashed showed that under the same conditions the washed coal burned much more rapidly than the raw coal, thus developing high rated capacities. In the average hand-fired furnace washed coal burns with lower efficiency and makes more smoke than raw coal. Moreover, washed coal offers a means of running at high capacity, with good efficiency, in a well-designed furnace.

Forced draft did not burn coal any more efficiently than natural draft. It supplied enough air for high rates for combustion, but as the capacity of the boiler increased the efficiency decreased and the percentage of black smoke increased.

Most coals that do not clinker excessively can be burned with 1 to 5 per cent greater efficiency and with a smaller percentage of black smoke on a rocking grate than on a flat grate.

Air admitted freely at firing and for a short period thereafter increases efficiency and reduces smoke.

As the CO in the fuel increases the black smoke increases; the percentage of CO in the flue gas is therefore, in general, a good guide to efficient operation. However, owing to the difficulty in determining this factor, combustion cannot be regulated by it.

The simplest guide to good operation is pounds of coal burned per square foot of grate surface per hour.

None of the problems of combustion have received more experimental treatment than the burning of coal in hand-fired furnaces. Hundreds of devices for smokeless combustion have been patented but almost without exception they have proved failures. This record may be explained by the fact that many of the patentees have been unfamiliar with all the difficulties to be overcome, or have begun at the wrong end. Numerous patents cover such processes as causing the waste gases to re-enter the furnace, and schemes for collecting and burning the soot are legion. So many manufacturers who have been looking for some cheap addition to a poorly constructed furnace to make it smokeless have experienced inevitable failure that the work of educating the public to rid cities of the smoke nuisance has been hard, long, and only partly successful.

The total number of steam plants having boilers fired by hand is far greater than the total of plants with mechanical stokers, but if the comparison is based on total horsepower developed the figures show

less difference. Particularly is this true in sections of the Central West, where mechanical stokers are generally used at large plants. As a general rule, hand-fired plants do not have proper furnaces, and methods of operation are far from conducive to good combustion. Coal is usually fired in large quantities, and little opportunity is given for the air and gases to mix before the heating surface is reached and combustion is arrested. In all the hand-fired plants visited success in smoke prevention has been obtained chiefly by careful firing. The coal was thrown on often in small quantities; the fire was kept clean, enough ash to prevent the passage of air through the fire never being allowed to collect on the grate; and more air was supplied at firing than after the volatile matter had been distilled. Even with such precautions the plants might have made objectionable smoke at times but for the fact that usually some method was employed for mixing the gases and air before they reached the heating surface.

Some general conclusions from the facts set forth in the bulletin are as follows:

The flame and the distilled gases should not be allowed to come into contact with the boiler surfaces until combustion is complete.

Fire-brick furnaces of sufficient length and a continuous or nearly continuous supply of coal and air to the fire make it possible to burn most coals efficiently and without smoke.

Coals containing a large percentage of tar and heavy hydro-carbons are difficult to burn without smoke and require special furnaces and more than ordinary care in firing.

Briquets are suitable for use under power-plant conditions when burned in a reasonably good furnace at the temperatures at which such furnaces are usually operated. In such furnaces briquets generally give better results than the same coal burned raw.

In ordinary boiler furnaces only coals high in fixed carbon can be burned without smoke, except by expert firemen using more than ordinary care in firing.

Combinations of boiler-room equipment suitable for nearly all power-plant conditions can be selected, and can be operated without objectionable smoke when reasonable care is exercised.

Of the existing plants some can be remodeled to advantage. Others can not, but must continue to burn coals high in fixed carbon or to burn other coals with inefficient results, accompanied by more or less annoyance from smoke. In these cases a new, well-designed plant is the only solution of the difficulty.

Large plants are for obvious reasons usually operated more economically than small ones, and the increasing growth of central plants offers a solution of the problem of procuring heat and power at a reasonable price and without annoyance from smoke.

The increasing use of coke from by-product coke plants in sections where soft coal was previously used, the use of gas for domestic purposes, and the purchase of heat from a central plant in business and residence sections all have their influence in making possible a clean and comfortable city.

The principal use of platinum is in electric furnaces to withstand high temperatures and in electrolytic appartus to withstand chemical corrosion.

LOGARITHMIC WIRING DIAGRAM.

RICHARD C. POWELL.

Oakland Gas, Light and Heat Company.

In the solution of most engineering problems, a graphic representation in the form of a curve or set of curves is extremely advantageous from two standpoints, at least. First, space is economized; more values can be gotten from a curve than can be printed in the same space in the form of a table. Second, a curve or diagram gives, as it were, a bird's eye view of the relations between the quantities over any range desired.

Several systems and devices of plotting are available, one of these being the use of a logarithmic scale.

In the construction of the wiring diagram devised by the writer, logarithms were resorted to in order to obtain a linear relation between quantities which involve a quadratic relation when expressed in the ordinary Cartesian co-ordinates.

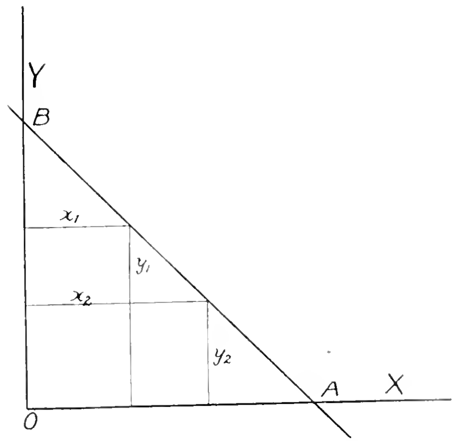
A very familiar formula for finding the drop in a copper wire is

$$V = \frac{10.7\ I\ d}{C},$$

where V = volts lost, I = the current in amperes, d = the distance in feet and C = the area, in circular mils, of the wire.

By rearranging this formula and taking logarithms, we have

$$(1)\quad \log V + \log \frac{C}{10.7} = \log I + \log d.$$



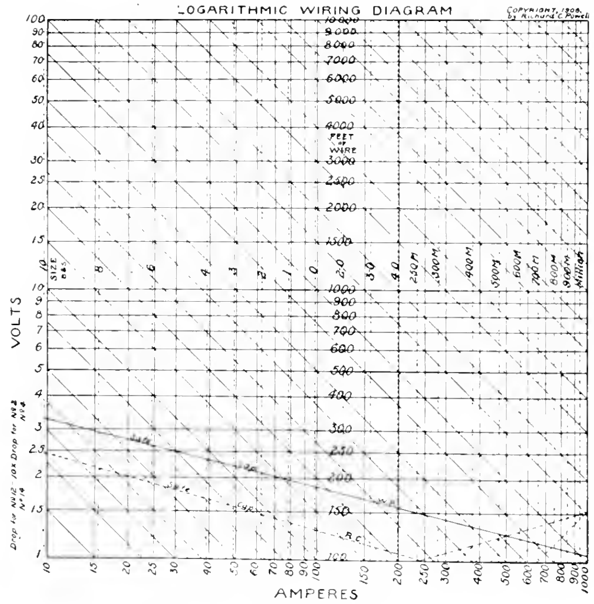
A line AB intersecting, at an angle of 45 degrees, the axes OX and OY of a rectangular system of co-ordinates has the property that the sum of the co-ordinates for any point on it is a constant and equal to the intercepts OA and OB. That is,

$$X_1 + Y_1 = X_2 + Y_2 = OA = OB$$

Therefore, if on OX we plot values of log V and $\log \frac{C}{10.7}$ and on OY values of log I and log d, and then construct a series of 45 degree lines, we have a graphical means for obtaining any four quantities which will satisfy equation (1).

The constant C has the effect of shifting all the co-ordinates of the variable with which it is associated. Therefore, it is combined with C since the co-ordinates of C as drawn will not, in general, coincide with the co-ordinates of the size, whereas the co-ordinates of volts and distance do.

In the diagram, the full vertical lines give amperes by following to the scale at the bottom. The dotted verticals are marked with the sizes and the full horizontal lines give either volts or distance, in feet of wire, according as one follows to the scale at the left or right.



Logarithmic Wiring Diagram.

From the preceding, it is clear that to obtain the proper relation between the four quantities, it is necessary merely to have the horizontal through "volts" and the vertical through "size" intersect on the same diagonal passing through the intersection of the vertical through "amperes" and the horizontal through "feet of wire." Let us take the diagonal through 200 on the "ampere" scale. The lines through 200 amperes and 100 feet intersect at the foot of this diagonal. Therefore, by following along this diagonal, we find that 100 feet of No. 4-0 wire will give 1 volt drop with this current; No. 0 will give a trifle over 2 volts; No. 1 about 2.5 volts and No. 6 about 8 volts. This also shows quite clearly the well known fact that for a given current and distance a wire three sizes smaller will double the drop.

Thus, the diagram gives, at a glance, the effect of any change in size, distance, amperes and volts drop. Also, with any three of the quantities given the fourth is readily found.

Since the safe carrying capacity of wires can be expressed in a linear logarithmic equation, by adding two straight lines we may extend the diagram to give these quantities. By following the diagonal through the lines "safe cap" and "size" to the "ampere" scale, we obtain the safe carrying capacity for either weatherproof or rubber covered. In the case of rubber covered wire larger than 250M, it is to noticed that the line bends up and the diagonals change direction, as shown by the dotted diagonals in the lower right hand corner.

For example, the safe capacity of No. 4 is 65 amperes for R. C. and 92 amperes for W. P., while for 600M we have 450 amperes for R. C. and 675 amperes for W. P.

Examples: What will be the drop in delivering 80 amperes a distance of 1500 feet, direct current (or single phase, if the effect of induction is neglected), using No. 4 wire?

Trace the vertical through 80 to its intersection with the horizontal through 3000. Then follow an imaginary diagonal through this point to its intersection with the dotted vertical marked 4. Tracing the horizontal through this point we obtain a drop of 60 volts. If, however, a drop of 20 volts is allowed, we find the proper size as follows: From the intersection of 80 and 3000 follow the diagonal to its intersection with the horizontal through 20 volts. The nearest size through this last point is No. 2-0.

What distance will No. 8 carry 25 amperes with a drop of 4 volts?

Find intersection of lines through 4 volts and No. 8. Trace diagonal through this point to intersection with vertical through 25 amperes. The horizontal through this last point is 250. That is, if we have two wires the distance is 125 feet. Neglecting induction, the distance for three phase is 250 feet.

How many amperes can be carried 2000 feet (2 wire direct current) with a drop of 15 volts, using No. 0 wire?

Through the intersection of the 15 volts horizontal and the No. 0 vertical follow diagonal to the 4000 horizontal. Following a vertical through this point, we obtain approximately 38 amperes.

Railroad ties are now being made from Japanese white oak. Several of the western roads have purchased a large quantity to be used in replacing worn out ties along their rights of way. The increasing cost of all railroad ties has naturally led the railroad companies to desire to prolong the life of the species of wood used, by preservative methods, and only recently an application was made to the United States Forest Service to conduct experiments at their Berkeley timber testing station to determine the value and life of the Japanese oak timber when properly treated. This application brought up the interesting point as to whether or not the Forest Service would be allowed to undertake experiments with foreign species of timber, inasmuch as the Act under which these experiments are carried on specifically requires that only American grown timbers shall be treated. The Forest Service has found it necessary, owing to pressure of other work, to decline to undertake this experiment, and therefore this point was not considered.

SUCCESSFUL REGULATION OF HIGHLY FLUCTUATING 60 CYCLE ALTERNATING LOAD.

BY O. W. LILLARD.

The recent installation of a storage battery regulation plant in Elmira, N. Y., is of particular interest to the generating plants of the Pacific Coast, as it is the home of alternating current practice. This was installed in the Madison Avenue Power House of the Elmira Water, Light & Railway Company after several years' consideration of the best method for obtaining the results desired.

This plant supplies a 3 phase, 60 cycle, 2200-volt incandescent service, a. c. arcs, d. c. arcs, a. c. power, 500-volt d. c. 3 wire power, 600-volt d. c. railway and high tension circuits to sub-stations on interurban line. Previous to the recent changes, the d. c. railway load was carried by a separate unit, and the arc and series incandescent lighting loads were carried by d. c. arc generators, belted four to an engine unit.

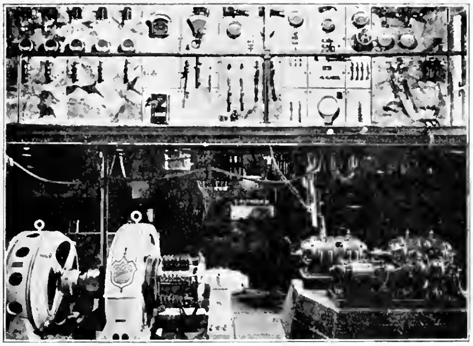
During periods of excessive fluctuations on the high tension and a. c. power lines, it was often found necessary to sectionalize the a. c. bus to avoid voltage fluctuations on the lighting circuits and prevent hunting between the alternators. This method of operation required considerable excess generating capacity, as each unit had to be capable of carrying the peaks of its circuit without help from the other generating units in operation. This proved a very serious trouble in the case of the railway generator, which, though of sufficient capacity to easily carry the average load, would at times be loaded almost to a standstill.

About a year ago, the load on this station increased to such a point that it became necessary to install additional capacity and at this time it was decided to totalize the entire load on the a. c. units; to discard the small engine units driving the arc lighting generators, and hold the d. c. generator as a reserve to be used in case of break down only. The two a. c. units in the station at the time were 750 and 500 k. w., 3 phase, 60 cycle, 2200-volt, also constant current transformers for approximately ½ of the arc circuits, a 300 k. w., 500-volt, three-wire rotary with transformers, and transformers to supply high tension circuits. The new apparatus installed consisted of a 2200 k. w., 3 phase, 60 cycle 2200-volt General Electric turbo-alternator, a 750 k. w., 6 phase, 600 volt shunt wound rotary with transformers, additional high tension transformers and a Gould storage battery of 280 cells, type S-615 in S-623 lead lined tanks, having a discharge capacity of 560 amperes for 1 hour (ultimate capacity when the tanks are filled of 880 amperes for 1 hour), with a regulating booster designed to operate the battery on momentary fluctuations up to three times the one hour rate.

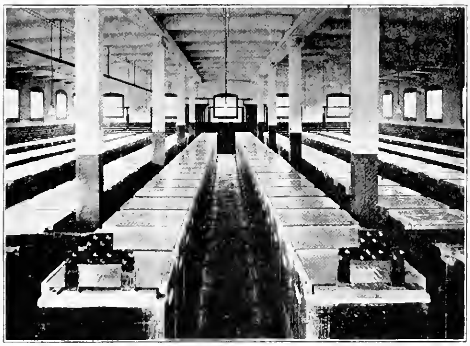
The switchboard was rearranged and the apparatus connected in accordance with the above requirements. Most of the d. c. arc circuits were changed to a. c. constant current systems, but in order to use the d. c. lamps in stock, it was decided to retain two of the d. c. circuits. This was accomplished by connecting two of the arc machines to an induction motor by means of flexible insulated couplings, thus making these two circuits part of the a. c. power load.

The regulating booster system installed in connection with the storage battery is novel, inasmuch as the battery charge and discharge are in accordance with the true energy component of the current in the 60 cycle a. c. circuit. To properly meet operating conditions it was necessary to place the series transformers controlling the booster set in the totalized "variable load" bus connection. This allows the battery to absorb the fluctuations of the variable load but makes the action of same independent of the lighting peak. This feature is very desirable in a plant of this kind, as it permits the removal of the rapid fluctuations (with their resultant overloading of the machines and poor regulation) with a battery of approximately 1-3 the size that would be required if the lighting peak were to be absorbed. This makes it practical to hold the regulated load constant within the close limits of 4 per cent measured on the true energy basis.

It will be noted that with this equipment, any of the generating units (with exception of the d. c. reserve) can be used to supply power to any of the circuits and that the generators are operated under practically constant load, the battery controlling apparatus being so designed that the "average load" supplied to the variable load bus can be changed at will without interruption of service. This makes it possible to use the net discharge capacity of the battery to



Regulating Equipment for A. C. Load.



Storage Battery and Room.

help out the alternators when such is required by simply lowering the average load. When this is done during the periods of light d. c. railway load, the rotary reverts and the battery supplies power directly to the a. c. bus through the rotary.

The advantage or reliability and economy of operation at direct current generating stations carrying highly fluctuating loads, by the use of storage batteries and regulating booster systems are well known. It is, however, of comparatively recent date that battery systems have been used to regulate fluctuating alternating current loads. In the case of the latter the advantages are even greater than in the case of the direct current systems as the close regulation of the true power delivered by the generators prevents changes of load on the prime movers with the resultant speed changes and hunting, thus permitting successful parallel operation where it would otherwise be impossible.

WOODWORTH DEMONSTRATION RULE.

Professor E. P. Woodworth of Lewis Institute, Chicago, has designed a slide rule for wiring calculations for the use of students in electrical engineering as illustrated herewith. On the upper scale is marked distance in feet, the two scales on the slide represent volts lost on the line and current in amperes, respectively, and the bottom of the rule comprises a composite scale, giving areas of wires in circular mils, diameters in mils, and sizes of wire in the B. & S. gauge. Thus the bottom of the rule is really a very compact and useful wiring table. The logarithmic arrangement of the B. & S. gauge is shown by the uniform spacing of the wire sizes on the bottom.

There is given the cross-section of the wire, its diameter and its size, all values corresponding to

American copper-wire practice. The wire scales are related to the upper scales on the basis of 10.7 ohms as the mil-foot resistance of copper. The number of feet per ohm is indicated approximately by the number of circular mils less one cipher. The two upper scales can be used for ordinary multiplication and division. Otherwise the rule is free from auxiliary mathematical scales.

The rule as shown is made up in pocket size of six-inch length. It is printed on bristol board, and can be readily mounted and shellacked. The bristol board itself may be folded so as to make a handy rule. While these rules are not claimed to be highly accurate, they have been found a very convenient practical working tool. Anyone sending his name and address to Lewis Institute will be furnished a copy of the rule shown, with the compliments of Professor Woodworth and of Lewis Institute. This rule is also made in standard slide-rule length.

LOCATION OF POLES AND WIRES.

BY EMERSON W. READ

There is one primary principle underlying the use of public highways by individuals or companies, alike, which, if duly and sincerely regarded, would prevent any question of right of use by public service companies from arising. To use the language of the Alabama Code, it is, "such lines shall be so constructed and maintained as not to obstruct or hinder the usual travel on such highway." The ordinary use of public highways is the essence of all considerations involving encroachments upon public thoroughfares for extraordinary purposes. This "ordinary use" is a subtle quantity and has been adjudicated upon in numerous appellate courts. Such expressions as "in no way to interfere with the safety and convenience of persons traveling," "common use," "not to interfere with repairs or public convenience in traveling," have been used to define it. If we follow the common law we can safely say that we are not encroaching upon the ordinary use if we do not obstruct the "use for which the highway was intended." Yet, even in this, remains the subtlety that was encountered before.

To obstruct the roadbed proper is no more obstruction of the highway than it is to interfere with the gutterway or sidewalk. As much is the gutter a part of the highway as is the bed proper, and it is so held. Poles planted and based in a gutter are not disallowed. It is possible to place them there and retain the free action of the gutter, but should interference be had with the operation of the gutter, then the poles become nuisances, interfering with the highway's ordinary use.

Persons using the highways can expect, by operation of law, the exercise of reasonable care by the company in erecting poles and wires, to the end that travelers be protected from injury from poles and wires while lawfully in the thoroughfare. In erecting poles and wires the company must take notice of prevailing conditions. What would be reasonable care in one instance would not suffice in others. As an instance, an insulater used in a sheltered valley with complete safety might not be adapted for use on a coast where heavy winds are usual at certain periods in the year. In other words, the equipment must be sufficiently strong to withstand usual conditions. "The poles must be strong enough to withstand such storms as may be reasonably expected, but they are not required to be so strong that no storms can break them, or to withstand such storms as reasonable foresight could not anticipate."

The wires may be so strung in elevation that the use and efficiency of a highway is impaired. It is held that individuals are making an ordinary and proper use of the highway in driving traction engines, tall

loads of hay and lumber, and like things, over them. While the law will not require wires to be so strung as to be elevated (that is, in the absence of statutes and ordinances) above exceptionally tall loads of hay or lumber, yet, reasonable loads are entitled to have free and safe passage. Especially at points where wires cross highways may interference be anticipated.

This proper elevation of wires and cross-arms has been determined in many statutes and "statutory elevation" is now recognized as an established thing. Such regulation is unquestionably a reasonable exercise of the police power, nor does the State or municipality part with such control by granting a franchise to a company thereby authorizing the erection of poles and wires on highways and streets. The State cannot grant away its right and duty to exercise the police power; consequently, the granting of a franchise to erect wires and poles cannot operate to divest the government of its duty to protect life and property by enforcing regulations as to construction and quality of work on public highways. As instances of such regulation,

1. Nebraska requires "telephone poles must be set at least six feet within the boundaries of the roadway and placed so as not to interfere with road crossings, while wires are to be placed not less than twelve feet above all road crossings";

2. Virginia requires "poles must rise at least twenty-three feet over road crossings and twenty-three feet over railroad crossings";

3. Ohio (perhaps the regulations of that State are as specific as any) requires "where the line is built over the track of a steam railroad, poles must be twelve inches in diameter at the bottom and six inches in diameter at the top, and set in the earth not less than one-sixth of their length and well tamped. Double cross-arms are to be used, and wires must be insulated with glass or porcelain insulators and securely fastened to both cross-arms. All wires are to clear the tops of rails at least twenty-five feet, except trolley wire crossings, where the height is to be agreed upon. Where there is any side strain poles must be well guyed or braced."

These are only instances of the regulations common to the States generally. California has enacted provisions, not so much of regulations and restriction, as for protection to companies, as will appear from the following sections quoted:

"Telegraph or telephone corporations may construct lines of telegraph or telephone lines along and upon any public road or highway, along or across any of the waters or lands within this State, and may erect poles, piers, posts or abutments for supporting the insulators, wires and other necessary fixtures of their lines, in such manner and at such points as not to incommode the public use of the road or highway or interrupt the navigation of the waters."

"Any person who injures or destroys, through want of proper care, any necessary or useful fixture of any telegraph or telephone company, is liable to the corporation for all damages sustained thereby. Any vessel which, by dragging its anchor, or otherwise, breaks, injures or destroys the subaqueous cable of a telegraph or telephone corporation, subjects its owner to the damages hereinbefore specified."

"Any person who willfully and maliciously does any injury to any telegraph or telephone property, mentioned in the preceding section, is liable to the corporation for one hundred times the amount of actual damages sustained thereby, to be recovered in any court of competent jurisdiction."

"No telegraph or telephone corporation can recover damages for the breaking or injury of any subaqueous telegraph or telephone cable, unless such corporation has previously erected on either bank of the waters under which the cable is placed, a monument, indicating the place where the cable lies, and publishes for one month in some newspaper most likely to give notice to navigators, a notice giving a description and the purposes of the monuments, and the general course, landings, and termini of the cable."

The record consumption of copper in the United States was 685,000,000 pounds in 1906. The largest exports ever made were those of 650,144,320 pounds in 1908. The maximum figures of domestic and foreign demand combined make a total of 1,335,144,320 pounds. According to the producers' figures for March, 1909, the United States production from domestic and foreign sources, based on the output for that month, was at the rate of 1,404,703,932 pounds a year. If, therefore, United States consumption and exports could possibly be stimulated to the record breaking rate they would still fall short by more than 69,000,000 pounds of the amount produced in this country from domestic and foreign sources at the rate attained last month. Then there was a stock of 182,279,902 pounds in this country on April 1, and 98,232,960 pounds in England and France on same date, making known stocks, here and abroad, of 280,512,862 pounds. A surplus of this size, and a record production, contemporaneously with restricted consumption, furnishes sufficient explanation as to the hard fight the market for copper has to hold its own even at present prices.

Wood Preservation is improved by removing all patches of inner bark so as to facilitate proper penetration of preservatives. In conducting some tests on the treatment of pine in Louisiana and Alabama, in 1907 and 1908, it was noticed by a representative of the Forest Service that very little or no creosote entered the wood through even the thinnest layer of adhering bark. In the creosote treatment of timbers, it is rarely that the entire stick is penetrated by the preservative. The value of the treatment consists largely in the creating of an exterior antiseptic zone around the untreated interior portion. If this outer zone be broken, the value of the treatment is to a large extent lost. In the case of piling, the effect of any small portion of untreated wood extending from the outer surface to the interior of the pile is especially injurious, because of the manner in which teredos work. The teredo enters the wood when small, making but a tiny hole, perhaps no larger than a pinhead. As they grow, they increase the size of their borings, and if present in large numbers, they will very quickly so riddle and weaken a pile, that it will break off with a very slight strain. Access to the interior of a treated pile might readily be gained through small untreated portions of the outer surface of the wood, which, because of bark adhering at time of treatment, absorbed no preservative, with the result that all of the interior untreated portion would be riddled, leaving only the exterior creosoted shell sound.

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CONTENTS

Electrical Safety Valves

In the early development of high tension transmission of electric power, considerable damage was done to apparatus by lightning discharges and unbalanced line conditions. Investigation as to the cause of this showed that lightning and high-frequency electric currents are identical. Consequently the term lightning is now applied to any phenomena due to abnormal voltage or frequency. Various methods are in use to minimize the damage caused by these discharges. Such protective devices are classified according to their action as either intermittent or continuous. In the first class is the horn type, which is essentially a single break to the ground, and the multi-gap arrester, which consists of a series of shunted gaps between non-arcing metal terminals. The first of these not only arrests the lightning, but also stops the entire system. The second is self-restoring after a single discharge, but is rendered inoperative by recurrent surges.

As distinguished from these intermittent arresters are the continuous devices, which act much like leaky safety valves in dissipating any voltage in excess of the normal. They offer a high resistance up to a critical voltage, above which the resistance is greatly lessened. In this latter type are those which use a jet of water to carry the leakage current, and also the electrolytic aluminum cell which is described elsewhere in this issue by Mr. A. G. Jones. This type short-circuits the excess voltage, but in so doing consumes a small amount of power which at times becomes great enough to seriously overheat the device. It is ordinarily installed at station bus-bars and used as an auxiliary check valve to the multi-gap or horn arrester. It forms the latest, but probably not the last word in lightning protection.

These methods for taking care of potential accumulation are alleviative rather than preventive. They are accident, rather than life insurance policies. In addition there should always be some form of line protection such as an auxiliary parallel or overhead grounded iron wire to withstand atmospheric lightning. While it is expensive to install such a system experience has shown that the outlay is well warranted by the subsequent safety effected. The internal surges are usually caused by an arc produced by switching or accidental short circuit, but besides these operative causes they may be due to faulty design or construction. The subject is one that requires constant vigilance and is illustrative of the "ounce of prevention worth a pound of cure."

CURRENT COMMENT

Storage batteries on street cars are to be tried by the Third Avenue Railroad Company in New York City, who will employ Edison nickel iron batteries. The line is three miles long and the installation is experimental.

The removal of rust from the iron bars of reinforced concrete is due to the reaction between the acid carbonate and sulphate in the cement and the oxide of iron. According to some recent investigations of Rohland, this takes place while the cement is setting.

Electro deposited copper tubes failed under the high steam pressure and temperature employed on the Lusitania. The pipe failed after one year's use, although it had been hydraulically tested up to twice the pressure of its working load of 105 pounds per square inch.

An electric hardening furnace described before a number of European societies and recently placed on the market by the General Electric Company consists of a crucible containing fused potassium and barium chloride. By varying the proportion of these salts definite temperatures up to 1400° C. may be had. Alternating current is used at 70 volts. The steel to be hardened is placed in the fused salts.

An electric ferry on the Rhine has been in successful operation for nearly a year between Godesberg and Niederdollendorf. It is driven by two 50 h. p. motors taking current at 300 volts from a 160 cell storage battery. The capacity is 335 ampere-hours on a one-hour discharge. The boat has a carrying capacity of 645 passengers, is made of steel with twin screws and a maximum speed of 7½ miles per hour.

Aluminum from clay has been produced in the electric furnace by Moldenhauer by treating a mixture of clay, hematite and coal. The reaction first produces ferro-silicon and fused alumina. This mixture is crushed and the alumna separated from the ferro-silicon by an electrico magnetic separator and then treated in a cryolite bath, yielding 70 per cent of metallic aluminum, with a valuable by-product in the ferro-silicon.

Investigation of water powers outside of national forests which are not included within withdrawals for reclamation purposes is to be undertaken by the United States Geological Survey. The findings are to be reported by Secretary of the Interior Ballinger to Congress, coupled with recommendations for legislation to control and regulate the disposition of power sites. The purpose is to prevent monopolistic or speculative interests from securing control of water power sites.

Nitrogen from the atmosphere is obtained by F. Beck by a new process, in which the nitrogen is passed through a molten alloy of magnesium and tin, the magnesium being charged to the nitrite, which is treated with steam to produce ammonia and magnesium oxide. The tin is recovered, and the magnesium oxide dissolved in melted carballite to be used as an electrolyte with a carbon anode and a molten tin cathode. By this process magnesium is formed at the cathode and unites with the tin, the process thus being continuous.

Colombian coal fields are well placed to take advantage of the markets which will be made available by the opening of the Panama Canal. There are at present three routes by which the coal can be sent to the canal: (1) From the Rio Hacha and Santa Marta fields to Colon, across the Caribbean Sea, 500 miles; (2) Darien to Colon, 300 miles; (3) Buenaventura, on the Pacific, to Panama, 400 miles. When the mouth of the Magdalena is opened for steamers and the navigation of the river improved coal may be exported by this additional route. The country has valuable coal fields, almost untouched and little explored, the mines that have been opened being worked in a very superficial way; the unsettled conditions which have prevailed in the republic having halted progress in this connection. No geological survey has ever been made of the Colombian coal fields.

A shorter cable to England is planned by the Commercial Cable Company of New York. It is proposed to cut one of this company's five transatlantic cables at the Flemish Cap, 300 miles east of Newfoundland, and to attach to the European end a new cable running to St. Johns, Newfoundland, and thence to New York City. It is expected that this redivision of the line between New York and Ireland will increase the speed of transmission by 35 per cent. This change has been made possible by the expiration of the exclusive rights of the Anglo-American Cable Company to land cable in Newfoundland. Some 1,700 miles of new cable will be laid if this plan is carried out and the 900 miles between the Flemish Cap and Canso, Canada, will be recovered and resheathed for use elsewhere.

Mexican governmental ownership of public utilities is rumored. The Federal Government is said to be looking into the practicability of acquiring 51 per cent of the stock of the Tramways Company and the Mexico Light and Power Company and operating them as the National Railways of Mexico are now operated. According to the reports, the project of the government is aimed directly at securing the public utilties for the sole purpose of benefiting the public at large and to create the most efficient service. President Diaz is said to favor the accomplishment of the idea, as it would carry out more completely his belief in public ownership and give the country the chance to at once forge ahead of all others in the important work already begun. It would enable Mexico to carry the problem of government control of public utilities to the stage never contemplated by any other government in the world.

PERSONALS.

M. L. Kohler of Philadelphia, Pa., has been elected president of the Chicago Mica Company of Chicago, Ill

P. J. Aaron, manager of the Seattle office of the Western Electric Company, spent a part of the past week in San Francisco.

Rudolph W. Van Norden has moved his offices from the Mutual Savings Bank Building to 409, 413 Union Trust Building, San Francisco.

H. R. Noack of the San Francisco office of Pierson, Roeding & Company, has returned from an extended business trip throughout the East.

E. N. Fobes, president of the Fobes Supply Company of Seattle and Portland, is in San Francisco after spending a week of recuperation at Del Monte.

Geo. A. Scoville, manager on the Pacific Coast for the Dean Electric Company, at San Francisco, left for a trip through the Northwest on April 26th.

P. L. Hoadley has charge of the Seattle office recently opened in the Central Building by the Sterling Electric Manufacturing Company of Warren, Ohio.

H. B. Vanzwoll, secretary of the Sunbeam Incandescent Lamp Company of Chicago, has been spending the past week or two in Southern California and is now in San Francisco.

Mr. E. M. Latham, purchasing agent of the Pacific Light & Power Company of Los Angeles, spent the early part of the past week in San Francisco in the interest of his company.

William Coale of the Sterling Electric Manufacturing Company, Warren, O., manufacturers of the Sterling incandescent lamp, is in San Francisco accompanied by Mrs. Coale

E. J. Koppitz, formerly sales engineer with the San Francisco office of the Western Electric Company, has joined the sales force of the San Francisco office of Fairbanks, Morse & Co.

Robert Kuhn of the American Electrical Heating Company, Detroit, Mich., left for the Northwest on Thursday night. Mr. Kuhn formed many friendships during his brief visit and his next trip to the Coast will be looked forward to with interest.

Theodore E. Burger, assistant manager of the California Electric Company, the Los Angeles branch of the Western Electric Company has been appointed manager succeeding Richard Spencer, former manager, who about six months ago was compelled to discontinue work owing to ill health.

OBITUARY.

John Chamberlin Fish, president of the National Electric Lamp Association and of the Shelby Electric Company, died April 16, after an illness of only four days. Mr. Fish was born in Sheldon, Vt., on April 14, 1864. Mr. Fish at the time of his death, aside from being interested in the electrical business, was president of the following companies: The Shelby Printing Company, the Shelby Water Company, the Ohio Seamless Tube Company and the Auto Call System Company, as well as vice president of the Shelby Telephone Company and a director in the Citizens' Bank—all of these being located in Shelby. Aside from endeavoring to benefit his place of residence in business ways, Mr. Fish also devoted a great deal of his time to the intellectual side, being president of the Board of Education. Mr. Fish was a member of the Knights of Pythias and Elk lodges and was president of the Colonial Club, of Shelby, and the Shelby Business-men's Association. He is survived by a widow and three sons, DeForest R., Cortez Carlisle and John C., and by his mother and one sister, with whom every one who has met Mr. Fish sympathizes in their affliction.

BOOK REVIEWS.

Law and Business of Engineering and Contracting. By C. E. Fowler; 162 pages, 6x9, numerous forms and blanks. McGraw Publishing Co., New York, and Technical Book Shop, San Francisco. Price, $3.00.

This author is best known by his work on "Ordinary Foundations." His wide experience in all parts of the country has eminently fitted him to give advice to young engineers. Older men, also, will find in it many worthy suggestions. After an introductory essay on the relation between the engineer and the contractor he takes up ordinary and special forms of contracts and specifications for various kinds of civil engineering work, illustrating his text with desirable forms and blanks. Valuable hints are contained in the chapters on the inspection of engineering work and estimating materials; likewise in that on bidding. Another chapter deals with organization of contract work and the concluding one gives a synopsis of the law of contracts.

Shop Tests on Electric Car Equipment. By Eugent C. Parham and John C. Shedd; 121 pages, 5x7½ inches, 55 diagrams. McGraw Publishing Company, New York, and Technical Book Shop, San Francisco. Price, $1.00.

The practical nature of this book is indicated by the refreshingly abrupt manner in which the authors get right to business, no historical summary or theoretical abstractions, but a plain explanation of how to do it. The first chapter deals with measurement of current, the second with measurement of voltage and the third with measurement of resistence. The methods given require instruments and other facilities that may be obtainable in a car house. Home-made outfits are described in detail. Succeeding chapters are concerned with high voltage insulation tests and armature tests, and conclude with directions for reviving shocked persons and relieving burns. The explanations and directions are simple and supplemented by many illustrations and practical directions. The whole is reviewed in a list of nearly 300 questions at the close of the volume.

TRADE CATALOGUES.

A neat postal from the Western Electric Company presents a graphic comparison of the advantages of the Improved Blue Bell Battery for telephone service.

An attractive catalogue covering fuse and service boxes arranged to take interchangeable conduit fittings, has been issued by the H. W. Johns-Manville Company of New York City.

In Bulletin No. 1656, from the General Electric Company, is described a current transformer for the measurement of large amounts of current; to be used on circuits, the potential of which does not exceed 2,500 volts.

The General Electric Company has issued Bulletin No. 1657, devoted to the subject of Searchlight Projectors for commercial use. This publication contains illustrations and descriptions of projectors of various types and sizes.

TRADE NOTE.

Hughson & Merton of 438 Market street have just completed arrangements for the opening of an electrical department and will act as representatives on the Pacific Coast for a number of eastern manufacturers. They announce that their list will include the Electric Cable Company of Bridgeport, Conn., manufacturers of insulated wires and cables of every description and insulating compound sold under the trade name "Voltax," and the Cleveland Switchboard Company of Cleveland, Ohio, manufacturers of switch and panel boards. This department will be under the management of Mr. Henry E. Payne, whose experience during the past few years in the machinery and electrical business, particularly equips him for this class of work.

THE AIR LIFT PUMP.

SAN FRANCISCO No. 1, N. A. S. E., listened to an interesting lecture on the subject of "The Air Life Pump" at their meeting of April 18th, by Mr. Sam Skelly, of Alameda, Cal. Mr. Skelly gave an informal talk, basing his remarks on the results of recent experiments and of a varied experience with the apparatus described.

He stated that the utility of the air lift for handling water is most evident where a number of wells are to be operated at some distance from each other, or from a central plant, and where large quantities of water are to be brought to the surface or water impregnated with mud or sand are to be pumped; these conditions making steam or power driven pumping machinery expensive to install, uneconomical in operation and costly as to maintenance. In such conditions the air compressor can be cheaply substituted for numerous pumping heads, and the air piped to the various wells at small expense. The air lift, if properly installed, will work satisfactorily with practically no attention, requires no repairs and will handle dirty water that would ruin a pump, without trouble or damage to itself.

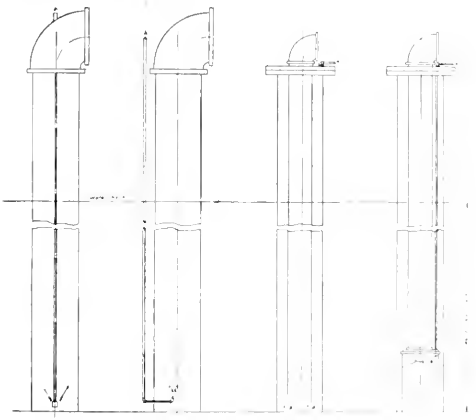


Fig. 1. Fig. 2. Fig. 3. Fig. 4.

The principle of operation of the air lift was simply explained as being the creation of an effective head between two columns of water by lessening the destiny of the discharge column with the introduction of air intimately mixed in the ascending column. In order that this head shall be practically effective there must be a degree of submergence proportional to the proposed lift. This was stated to be about 60 per cent for a reasonable efficiency. Under such conditions as high as 75 per cent efficiency has been attained. When the quantity of water raised is greater than the supply, causing a reduction of level and less submergence, the efficiency decreases rapidly, approximately as the cube of the distance of drop of water level. Greater submergence than 60 per cent, however, gives no additional advantage and where the depth of water exceeds this the apparatus should be submerged only the necessary depth.

Four main systems of applying the air jet are in use for each of which certain advantages are claimed. They are, as illustrated, as follows: Fig. 1, The upturned jet; Fig. 2, The capped; Fig. 3, The central pipe, and Fig. 4, The design used by the United States to a great extent. Of these the third arrangement shown is the one adopted in the experiments mentioned. No 1 is inefficient for the reason that the air tends to form a central hollow column and escape without effect on the water. No. 2 is applicable only to screwed casing and has no advantages over the other methods. No. 4 is efficient and is practically the same as No. 3. The air jet is preferably a number of small holes with an area aggregating a little more than the area of the air pipe. These holes should be placed in staggered rows around the circumference of the pipe and inclined upward at about 70 degrees from the horizontal. Fig. 5 is a sketch of an improved jet designed and manufactured by Mr. Skelly, wherein the air is introduced in a film and which gives a constant flow of water.

An empirical rule for determining the size of discharge pipe to use for ordinary purposes is as follows: Provide one square inch area of discharge pipe for each 4 cubic feet of free air capacity of compressor. This rule gives excellent results for the usual conditions found. An air pressure of four atmospheres is found to give best results under the same conditions. The substitution of several small pipes of equal aggregate area instead of one large pipe for the discharge gives better efficiency on account of the fact that the tendency of the air to create a hollow column inside the large pipe is thus overcome. This arrangement is also easier to install on account of the smaller pipe used.

In cases where the discharge is to be in elevated tanks at some distance from the well, it is necessary to carry the discharge directly to the necessary height and then terminate with a horizontal run, or where this is not feasible a stand pipe may be provided to receive the water from the well and otherwise piped to the storage tank.

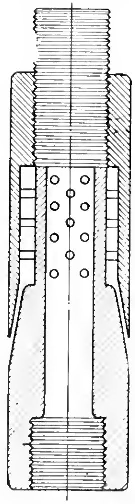


Fig. 5.

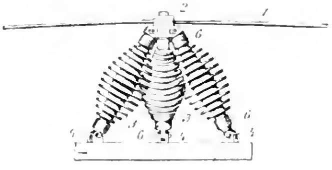
The apparatus will not work satisfactorily with a horizontal run in the discharge below the level to be reached on account of the fact that the air being lighter than the water will separate from the column and leave it dense at the bottom of the pipe.

Under certain conditions a dual system may be installed, using the air lift to bring the water near the surface, and from that point taking it with a suction and lift pump to the tank. The cup at the bottom of the pump suction collects the water from the air lift column, the air passing on upward, providing a continuous supply to pump. This system is applicable to deep wells where the conditions will not permit the use of the air lift alone and where a deep well pump is not advisable.

There are many cases where the use of an air lift instead of a pump is attended with incidental advantages, as when the water is to be used for cooling or condensing purposes. The refrigerant effect of the expanding air being sufficient to lower the temperature of the entire body of water, in some cases as much as twenty degrees.

PATENTS

917,785. Insulating Support for High Tension Conductors. Ralph D. Mershon, New York, N. Y. An insulating support for high tension conductors, comprising a framed structure, for resolving mechanical forces originating in the conductor into



components, having component-resistant members each consisting of an elongated body of insulating material provided with metal connecting caps at its ends.

917,796. Electric Furnace. James H. Reid, Newark N. J. An electric furnace having a plurality of horizontally extending electrodes of different polarity adapted to constitute a

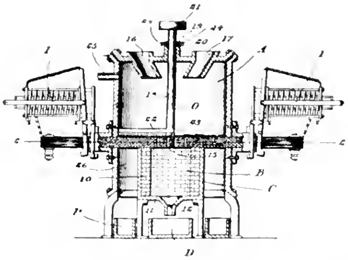
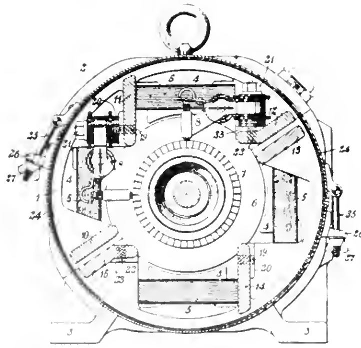


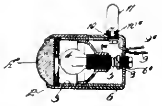
table within the furnace and to produce arcs between, and a sweep adapted to spread the ore on the electrodes and clean it off of the same.

917,806. Electric Motor. Robert Siegfried, Pittsburg, Pa., assignor to Westinghouse Electric & Manufacturing Company. In an electric motor, the combination with a field magnet frame that is open circumferentially at the commutator end



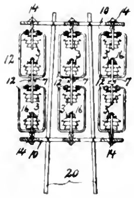
and is provided with brush-supporting ribs, of a two-part cylindrical commutator cover, and means for clamping the cover parts together with their adjacent edges in any desired angular position with reference to the base of the motor.

918,181. Electric Flashlight Attachment. Frederick Meadows, Berkeley, Cal., assignor of one-half to Herbert B. Cornwell, Berkeley, Cal. The combination in a device of the character described, of a two-part separable casing carrying respectively a magnifying lens and terminal contacts, a reflector



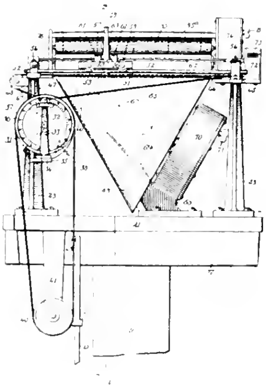
bracket upon opposite ends of which the casing sections are telescoped, an incandescent lamp mounted in the bracket, a conducting finger ring fixed to the casing, an elastic arm concentric, and normally out of contact with the ring, and insulated from the casing, and electric connections through the lamp with the ring and the arm.

918,339. System of Insulation for High Voltage Electric Conductors. Fred M. Locke, Victor, N. Y. A system of insulation for high voltage conductors comprising suitable supports, and a series of insulators arranged in sequence between



the supports, and tie pieces connecting the insulators and supports and exerting compression strains upon the insulators.

918,176. Water Meter. Chris Lory, New Windsor, and Charles A. Lory, Fort Collins, Colo. The combination of a carriage, means controllable by changes in water level, for shifting said carriage into different positions, a revoluble member mounted upon said carriage, a comptometer connected with said revoluble member and actuated thereby,



rollers mounted upon said revoluble member in order to facilitate the travel of the carriage, and a conical driving member engaging said rollers for the purpose of turning said revoluble member.

INDUSTRIAL

GOERIZ CENTRIFUGAL TURBINE PUMPS

BY OSCAR C. GOERIZ.

A novel form of turbine pump has been patented and developed by myself. This pump is so designed that all end thrust is eliminated and is so constructed as to be readily adjusted for efficient working. With regard to the latter point reference to Fig. 1 shows that in a centrifugal pump the discharge openings of the runners "A" must coincide, as closely as possible, with the entrance openings "B" into the diffusion passages. If they should happen to be "out" the pump delivery would be choked to some degree, which would tend to cut down the pump efficiency, in addition to limiting the amount of water handled. When a pump is assembled in the shop, a mark "M" on the shaft calls for a certain length of gauge "D" between a fixed point and this mark, to show that the runners are in proper place. This is a useful innovation to determine from the outside, whether the runners are center to center with the diffusion vanes.

Ring "G" in the position shown in the cut would allow full leakage of the discharge pressure into the chamber formed between the runner tip and suction opening, thus creating a thrust force which acts to the right. Now if this ring

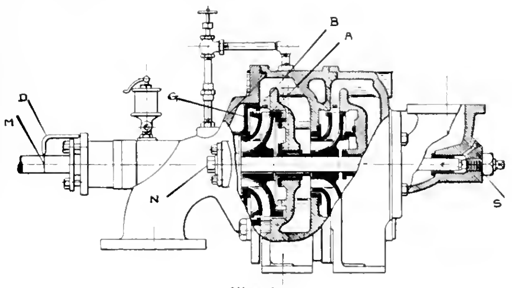


Fig. 1.

"G" is pulled to the left by means of the nuts "N" which operate the ring "G" by studs, or in any other suitable manner, it is evident, and that the leakage will be reduced and finally nearly stopped, and that the pressure in the chamber can be brought down to suction pressure or to a partial vacuum, producing a powerful axial force acting to the left. Any intermediate position of the ring thus creates any axial force between these opposite extremes as determined by areas and possible water pressures. This enables us to balance any axial thrust by means of artificially altered hydraulic opposing forces.

The axial thrust encountered in centrifugal pumps has been a particular source of trouble, because it varies according to the conditions of wear and tear at the various points where leakage takes place, namely the runner tips and wearing rings. Most firms provide heavy collar bearings which not only add to the expense of the construction but also waste energy by mechanical friction and reduce the pump efficiency.

In the construction described here there is provided a temporary step "S" which is only used at the start when adjusting the thrust balancing ring. Experience extending over a lengthy period has shown that the ring must not be touched for a long time after the original adjustment, as it is automatically taking care of the variations of the pump thrust. The gauge "D" shipped with every pump affords an easy means of control and the instruction given to the men simply reads: "If the mark "M" does not coincide with gauge distance "D" shift the ring "G" in the same direction the shaft ought to be moved to bring mark to gauge distance. When shaft and runners are in proper position, ascertained by gauge, the temporary step "S" should be just clear of end of shaft, say 1-16 inch.

Fig. 2 illustrates a vertical 5 inch mine pump of two stage design for 500 gallons per minute to 175 feet total head direct coupled with a Westinghouse electric motor running at 1800 r. p. m. While in such a pump it could be easily arranged to operate the thrust balance ring from the above this was not found to be needed as no readjustment of the ring was required after a number of months running with gritty water. The collar bearing provided for in this pump has simply the purpose of taking care of the revolving weights whenever the pump unit is stopped or started again.

The Risdon Iron Works of San Francisco, which have in addition to many other pumps manufactured the patented pumps

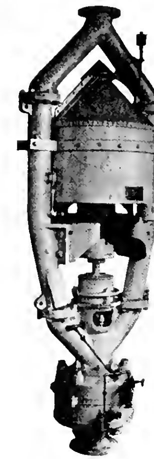


Fig. 2.

listed below, deserve credit for the good workmanship, enabling us not only to attain, but mostly even to exceed the efficiency guarantees.

2 pumps for 125 gallons per minute each, to 240 feet total lift.
1 pump for 500 gallons per minute each, to 75 feet total lift.
1 pump for 400 gallons per minute each, to 75 feet total lift.
2 pumps for 1,100 gallons per minute each, to 300 feet total lift.
1 pump for 800 gallons per minute each, to 75 feet total lift.
1 pump for 4,000 gallons per minute each, to 100 feet total lift.
1 pump for 750 gallons per minute each, to 115 feet total lift.
1 pump for 900 gallons per minute each, to 125 feet total lift.

With the exception of the two pumps mentioned first which are belted, all the other pumps are direct coupled to electric motors. The pump named last in the list has an electric motor placed between the two 2-stage pump halves coupled on either side; with a by-passing pipe arrangement the pump halves working in parallel perform the above duty, while running in series they deliver about 300 gallons per minute to 300 feet pressure for fire service.

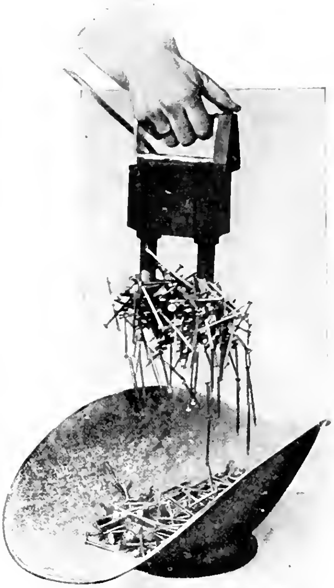
Every year there are a great many patents issued, some of which are never put into practice, and it is therefore very gratifying to the writer that in spite of business depression we are able to publish a list of the patented pumps built or in course of construction, which may prove that a good start has been made to exploit this invention.

A HANDY MAGNET.

Something new in the lifting magnet line has been placed on the Market by the Cutler-Hammer Clutch Company of Milwaukee, whose large lifting magnets are widely used in the iron and steel industries for handling pig iron, scrap, etc. The new device is a hand magnet weighing about 7 pounds, but capable of lifting castings of from ten to fifteen times its own weight.

The magnet is designed for operation on 110-volt direct current circuits and is furnished with drop cord and attachment plug so that it may be readily attached to any ordinary lamp socket. The push-button mounted on top of the magnet and operated by the thumb closes the circuit to the coils and makes the magnet operative. On releasing the button the poles become demagnetized and the load is released.

It seems to be capable of many useful applications. In machine shops it is used for clearing chips and borings out of the machinery or removing them from parts of the work not easily accessible, as for instance from the bottom of a deep cylindrical casting. Dropped tools, bolts, boring bars, etc., are easily recovered with the aid of the magnet from places from which it would be difficult to fish them my ordinary means.



Cutler Hammer Lifting Magnet.

In shops where large quantities of brass and iron filings accumulate and which it is desirable to separate before selling as waste material, the magnet is especially useful since brass being non-magnetic is not attracted by the magnet, like iron, thus enabling the two metals to be separated by merely passing the magnet through the mixed metals. In the same manner tacks or nails can be separated instantly from brass screws with which they have become accidentally mixed.

In foundries this magnet may be used to pick up hot or awkwardly shaped castings; smooth plates, which are sometimes difficult to secure a hold on when laying on a flat surface, or for cleansing the molding sand of minute particles of metal.

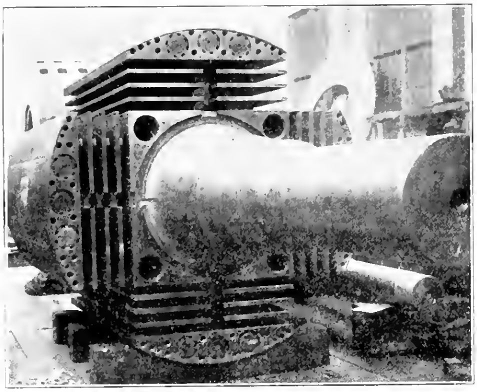
Suspended with its two poles immersed in the liquid the magnet will attract to itself any particles of iron or steel, which it may be desired to remove from the tubs in which paints, glazes, chemicals, etc., are mixed.

One purchaser, who uses several automobile trucks in his business, has put this magnet to a novel use. He is paving an alley in the rear of his store with ashes and finding that many nails from packing boxes, burned under the boilers, were mixed with the ashes he is now guarding against punctured tires by employing a magnet to remove nails from the ashes before strewing them in the alley.

In the shipping departments of large establishments many hundreds of nails are recovered daily by hand from the sweepings. For work of this sort, or for handling nails, nuts, screws, etc., in hardware stores the little magnet here illustrated should prove useful. Otis & Squires are the San Francisco representatives of the Cutler-Hammer Clutch Company.

WESTINGHOUSE PROGRESS.

The improvement in the business of the Westinghouse Machine Company's shops at East Pittsburg, which has been noticeable for several months, continues in the most encouraging degree. Since the first of April quite a number of orders for steam turbines, steam engines and gas engines have been booked, and the record for the first two weeks of this month shows a considerable increase over the same period of March. With the anticipated closing of quite a number of contracts for which negotiations are now pending, the indications are that the April business will make an excellent showing. Among the contracts particularly worth mentioning which the company has lately received is an order from the City Electric Company of San Francisco for a 15,000 horsepower steam turbine. This will be the most powerful steam turbine installed west of the Mississippi, its power capacity being about equal to ten of the largest size express railway locomotives. This company has already installed three Westinghouse steam turbines of a smaller size. The East Pittsburg shops are also turning out at present on order from the City of Detroit a 5000-horsepower steam turbine, and another of the same size is going to Nichols Copper Company of Laurel Hill, Long Island, while the Saginaw & Flint Railway Company of Michigan has contracted for an 1150 horsepower turbine and the Alaska Treadwell Gold Mining Company of San Francisco has ordered two 1000-horsepower machines of the same type.



Rotating Field of 15,000 h. p. Turbine Generator Set for City Electric Company.

NEWS NOTES

FINANCIAL.

SIERRA MADRA, CAL.—Bonds, amounting to $30,000, are on sale this week for the erection of a municipal gas plant.

LOS ANGELES, CAL.—Bonds have been issued in this city to the amount of $150,000 for extending the electric light system.

PASADENA, CAL.—The $150,000 municipal lighting bonds issued here were bought this week by the First National Bank of this city.

FRESNO, CAL.—The proposed $1,000,000 bond issue for the Fresno-Hanford Interurban Railroad will be purchased by the Cleveland Construction Company. Over $250,000 is to be spent in wages in the next few months. W. E. Davis of the Cleveland Construction Company is superintending the construction work.

OAKLAND, CAL.—The gross earnings of the San Francisco, Oakland & San Jose Railway Company for March, 1909, show an increase of $500 over March 1908. The net earnings increased $4,000. The official statement for March is as follows:

	1909.	1908.
Gross earnings	$233,992.36	$232,491.35
Operating expenses	32,749.01	38,228.27
Net earnings	$40,416.78	$36,370.46
Fixed charges	23,142.06	20,851.90
Surplus	$17,274.72	$15,518.56

OAKLAND, CAL.—The March, 1909, gross earnings of the Oakland Traction Company show an increase of $1,500 over March, 1908. The net shows a decrease of $6,000, owing to increased operating expenses, caused by the opening of new lines in Berkeley. The statement for March is as follows:

	1909.	1908.
Gross earnings	$233,992.42	$232,491.35
Operating expenses	116,302.42	108,636.01
Net earnings	$117,689.94	$123,858.34
Fixed charges	45,367.28	45,872.41
Surplus	$ 72,322.66	$77,985.93

TRANSMISSION.

EUREKA, CAL.—A. Tinsley has located 10,000 inches of the waters in Campbell Creek, near here, for power purposes.

CITY OF MEXICO, MEX.—Augusta Pellet has applied for the right to use the waters of the Tequesquipan river for generating electric power.

PASADENA, CAL.—The present power house at Mt. Wilson is to be replaced by a modern concrete building with steel roof, and improvements are to be made in its equipment.

SANTA BARBARA, CAL.—Bids will be received by the Santa Barbara (Cal.) City Council up to May 6th for a franchise for the construction of an electric distributing system in the city.

BAKERSFIELD, CAL.—Superintendent W. S. Cone, of the Edison Electric Company, states that the Kern River plant is still out of commission and the company is awaiting the arrival of machinery from the East.

SAN FRANCISCO, CAL.—Inspector David Atkins, of the United States Treasury Department, is now in this city superintending the installation of a $40,000 auxiliary power plant to be installed at the United States Mint.

SPOKANE, WASH.—The Spokane-Orient Power Company has been incorporated here with a capital stock of $1,000,000 by C. A. Luncheford, C. H. Patten, A. R. Patten and others. The company proposes to generate electric power on Boulder Creek, where a water-right has been secured, with a fall of 300 feet, capable of developing 2,500 horsepower.

SEATTLE, WASH.—The Entiat Power Company has voted to increase its capital stock from $50,000 to $200,000. The Entiat Company has been at work at the plant at Entiat for some time and has already completed a large dam in the Entiat River, constructed the canal and prepared a site for the power house. It is the intention of the company to put in one of the largest plants in Central Washington.

INCORPORATIONS.

OAKLAND, CAL.—The Electric Equipment Company has been incorporated here by G. F. Bulen, J. G. Wallmann and M. H. Bulen.

SAN FRANCISCO, CAL.—The Gilroy Gas Works has been incorporated here with a capital stock of $50,000 by D. O. Druffel, M. Flaherty and L. P. Lowe.

COALINGA, CAL.—The Pacific States Petroleum Company has been incorporated here with a capital stock of $300,000 by G. W. Richard, E. J. Broberg and Con O'Donnell.

SAN FRANCISCO, CAL.—The Paula Oil Company has been incorporated here with a capital stock of $750,000 by F. L. Brown, C. B. Simmons, C. B. B. Barnes, H. M. Brittan and G. K. Walker.

RED BLUFF, CAL.—The Butte & Tehama Power Company has been incorporated here with a capital stock of $1,000,000 by Luke McDonald, L. A. McIntosh, R. S. Kitrick, J. E. Frick and Leon Bly.

SAN JOSE, CAL.—The Bell Oil Company has been incorporated here with a capital stock of $1,000,000 by E. F. Wayland, C. A. Barlow, J. H. Stewart, H. McFadden, H. E. Bell, B. A. Herrington, P. Taminelli and J. A. McCarley.

MEXICO CITY, MEX.—The Mexican National Gas Company has been incorporated here with a capital stock of $2,500,000. The officers and directors are: President, J. L. Doheny; first vice president, C. A. Canfield; second vice president, R. H. Miner; secretary and treasurer, Norman Bridge; directors, E. P. Ripley, R. O. Bradley, W. L. Hardin and Harold Walker. Offices will be maintained in Los Angeles. The company is now buying its generators, boilers and other equipment.

LOS ANGELES, CAL.—The International Oil Refining Company has been incorporated here with a capital stock of $1,000,000. The new company proposes to build a $100,000 refinery at Thenard Junction, on the inner harbor of San Pedro, where 49 by-products will be manufactured from the California crude oil. The officers of the company are: President, J. Lamb Doty; vice president, F. S. Rishel; secretary and treasurer, G. Holman Coffin Jr.; and directors, Charles Rixon Jr. and Dr. J. Addison Jackson. A right of way for pipe lines to the outer harbor at San Pedro has already been secured.

ILLUMINATION.

AZUSA, CAL.—Bids will be received by the City Council up till June 7th, 1909, for a gas franchise in this city.

COALINGA, CAL.—A. W. Smith and S. H. Hain were granted a franchise this week to construct a gas distributing system in this city.

SAN FRANCISCO, CAL.—The San Francisco Gas & Electric Company, let contracts this week, amounting to nearly $30,000, on their new building at Sutter and Stockton streets.

SACRAMENTO, CAL.—An ordinance has been passed in this city whereby all electric poles in the business district excepting trolley poles, must be removed and wires placed underground.

WASHOUGAL, WASH.—The Western Light & Power Company, under the management of C. W. Cottrell, intends to install a 450 horsepower electric plant on the Washougal river, one mile above Washougal.

FORT BRAGG, CAL.—The Fort Bragg Electric Light Company will enlarge its plant soon in order to keep pace with the growing business. A new dynamo of 750 kilowatt capacity will be installed during the summer.

SAN LUIS OBISPO, CAL.—President W. F. Boardman of the San Luis Gas & Electric Company, announces that four miles of new gas mains are to be installed this summer. The company is also to make several improvements at its generating plant.

MONTEREY, CAL.—Th Monterey County Gas & Electric Company will begin installing soon a new gas plant at its works in this city which will cost $20,000. A transmission line is also to be built to Salinas for lighting and power purposes in that city. This will require an expenditure of over $30,000.

TURLOCK, CAL.—Superintendent Arch Scott, of the La Grange Water & Power Company, has a gang of men at work in this city constructing the new electric light and power system. He states that electric power will be in Turlock in about three weeks. Offices have been opened under the local management of A. S. Hunt.

SEATTLE, WASH.—Steam that has been going to waste in the city incinerator plant at the south end of Lake Union is now being utilized to generate electricity One 250 horsepower generator has been installed, which furnishes electricity for lighting the incinerating plant, operating and lighting the city asphalt plant and driving a 1,000,000 gallon pump recently installed in the incinerating plant Plans are being considered to furnish electricity for lamps to nearby buildings.

OAKLAND, CAL.—Manager F. A. Leach Jr., of the Oakland Gas, Light and Heat Company, announced this week a reduction in the Alameda County electric light rates from 9 cents per kilowatt to 4 cents. The rate to be charged for all current for heat will be 3 cents per kilowatt. This cut was made in order to underbid the rates offered the county by Charles L. Pryal, representing the Central Oakland Light & Power Company, who offered to save the county $400 a month.

TRANSPORTATION.

SANTA BARBARA, CAL.—Bids will be received up till June 7th, 1909, for the sale of an electric franchise along certain thoroughfares in the city.

SACRAMENTO, CAL.—The Vallejo & Northern Railway Company has been granted a franchise to operate electric lines on certain thoroughfares in this city.

SANTA BARBARA, CAL.—Bids for the sale of the street railway franchise applied for by the Pacific Improvement Company will be received in this city up till May 6th, 1909.

OAKLAND, CAL.—President F. A. Heron, of the Oakland Traction Company, has announced a reduction to 5 cents on the Leona Heights suburban line between Vernon station and Oakland.

LOS ANGELES, CAL.—The Los Angeles Railway Company is soon to reconstruct its lines on Spring street, between Fifth and Ninth. Crushed rock ballast will be put down and the 60-pound rails now in use will be placed by 70 pound rails.

CHICO, CAL.—The Northern Electric Company is now engaged in reconstructing its Hamilton Branch from this city. Over 2000 feet of track was washed away by the floods of January and the company is pushing the work to completion as rapidly as possible.

OIL.

TONOPAH, NEV.—The Pioneer Water Company has been granted a franchise to lay pipe lines in this city.

ANTIOCH, CAL.—The California Powder Works will building its pumping station in this city, where water will be forced from the river to the works, about four miles away.

LARKSPUR, CAL.—The Wright Water Company of this city has been leased for three years by LeCornec & Larkins. The new management intends to increase the storage capacity of the plant and improve the service generally.

SANTA BARBARA, CAL.—The Union Oil Company has been granted a permit by Acting Secretary Oliver, of the War Department, to build a pipe line from its works at Santa Barbara 2,000 feet into the Pacific Ocean, and to erect a dolphin at the outer end to pump the oil into ships.

WATSONVILLE, CAL.—A valuable oil flow, which has been creating much excitement in this vicinity, was struck this week at the Watsonville Oil Company's site a few miles east of here. The flow, which runs high in gasoline, averages 250 barrels a day and a great quantity of gas is produced.

OAKLAND, CAL.—M. J. Laymance of this city purchased last week for $200,000 oil land in the Mariposa Oil District, near Los Angeles. This property was sold less than three months ago for $150,000. Mr. Laymance has already placed large orders for machinery with Oakland firms, and no time will be lost in establishing a working plant on the field.

TELEPHONE AND TELEGRAPH.

SAN LUIS OBISPO, CAL.—George Jessup, representing the United Wireless Telegraph Company, is now in this city selecting a location for a station. This company has now nearly 30 stations on this coast, the last one being installed at Monterey.

SAN FRANCISCO, CAL.—The Telephone Rates Committee of the Board of Supervisors has passed to print recommendations which will reduce the present income of the Pacific States Telephone & Telegraph Company between $60,000 and $65,000. The committee assured the company of an income of at least 8 per cent upon its invesment. Increases in the number of switches allowed without extra charge were made as follows: Under the $5 a month rate, from 42 to 60 switches; under the $9.15 a month rate, from 125 to 175 switches; under the $12.47 rate, from 209 to 300 switches; under the $15 rate from 292 to 400 switches; under the $17.48 rate, from 500 to 600 switches; under the $19.57 rate, from 667 to 780 switches. A new rate of 25 cents a day was also provided for single telephones with five switches without extra charge, additional switches to be charged for at 4 cents each. A rate was also created of $3 a month for a single party residence line, carrying 125 switches without extra charge, with a charge of 3 cents each for additional switches.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer—who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

ADAPTERS

Lamp Adapters

American Eveready Co.
Benjamin Electric Mfg. Co.
Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Perkins Elec. SwtchMfg.Co.

ALARMS.

Burglar Alarms

Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc.
Western Electric Co.

Fire Alarms

Edwards & Co.
Partrick,Carter&WilkinsCo.
Western Electric Co.

Water Alarms

Partrick,Carter&WilkinsCo.

ANCHORS

Johns-Manville Co., H. W., "J. W."
Kierulff, B. F. Jr. & Co., "Hubbard."
Klein & Sons, Mathias.

ANNUNCIATORS

Edwards & Co.
Elec. Goods Mfg. Co., "Ross," "Rivol," "Perfect," "Noxall."
Patrick, Carter & Wilkins Co., "King."
Standard Elec. Works, "C. & S."
Stanley & Patterson, Inc.
Telephone & Elec.Equip.Co. "Holtzer-Cabot & Co."
Western Electric Co.

ARMS.

Cross Arms

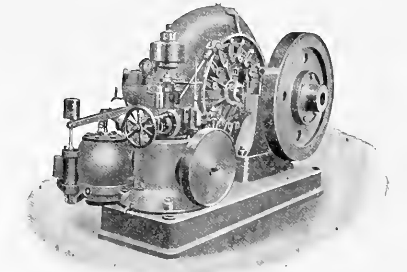
American Cross Arm Co. "Walworth & Neville."
California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

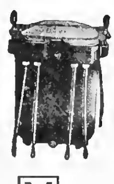
Mast Arms

Elec. Appliance Co., "Cutter."
Ft. Wayne Electrical Wks
Kierulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher."

Desk Phone Arms

Dean Electric Co.
Electric Appliance Co., "Eaco."
Kierulff, B. F., Jr. & Co., "Sterling."





INDEX TO ADVERTISEMENTS

Sterling Elec. Co.
Western Elec. Co.

ASBESTOS

Johns-Manville Co., H. W.

AUTOMOBILE ACCESSORIES

American Eveready Co., "Ever Ready."

BATTERIES

Dry Batteries

American Eveready Co., "Ever Ready" and "Crescent."
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Standard Electric Works, "Standard."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

Dry Battery Holders

Brooks-Follis Elec. Corp.
Stanley & Patterson, Inc., "Patterson."

Medical Batteries

Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Electro - tonic," "Vetter."

Wet Batteries

Brooks-Follis Elec. Corp.
Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

Storage Batteries

Elec. Storage Battery Co.
Westinghouse Machine Co.

BELLS

Electric Bells

Brooks-Follis Elec. Corp.
Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

Electro-Mechanical Gongs

Brooks-Follis Elec. Corp.
Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.

Magneto Bells

Brooks-Follis Elec. Corp.
Dean Electric Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Switchboard & Supply Co.
Standard Electric Works, "C. & S."
Western Electric Co.

BOILERS

Henshaw, Bulkley & Co.
Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, "Edge Moor."

BOXES

Floor and Outlet

Krantz, H., Mfg. Co.

Junction Boxes

Krantz Mfg. Co., H.

Wall Boxes

Brooks-Follis Elec. Corp.
Benjamin Elec. Mfg. Co.
Bossert Electric Construction Co., "Bossert."
Chase Shawmut Co., "Knockout."
Chicago Fuse Wire & Mfg. Co., "Union."

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity Power and Gas *604 Mission Street, San Francisco.*

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.

Journal of Electricity, Power and Gas,
601 Mission Street, San Francisco.

AGENTS WANTED on a guaranteed weekly salary to represent our two publications, "Southern Engineer" and "Southern Machinery"; liberal terms for exclusive services; easy sellers; every engineer and every machinist is interested. Write at once. For further information, address W. R. SMITH PUB. CO., Sub. Dept., Atlanta, Georgia.

WANTED—Men coming in direct touch with Steam, Electrical Superintending Engineers and Shop Foremen. A proposition that can be handled by energetic persons to good advantage. Liberal commission and permanent work. CHAS. L. TURNER, 907 Atlas Bldg., San Francisco, Cal.

SITUATION WANTED—By electrical engineer with 15 years' experience in designing and estimating of electric power plants, switch gears, light, motor and storage battery installations; also in central station service. Advertiser takes also draughting work in this line as home occupation if no steady engagement can be attained. Moderate expectations. Address Box 101, **Journal of Electricity,** San Francisco.

WANTED—Trustworthy man or woman in each county to advertise, receive orders and manage business for New York Mail Order House. $18.00 weekly, position permanent; no investment required. Previous experience not essential to engaging. Spare time valuable. Enclose self-addressed envelope for full particulars. Address Clark Co., Wholesale Dept., 103 Park Avenue, New York.

Cutter Co., The. "Munit."
Electric Appliance Co., "T. & B."
General Electric Co.
Krantz Mfg. Co., H.
Paiste, H. T. Co.
Pass & Seymour.
Sprague Electric Co., "Universal."
Standard Electrical Works, "M. & M."
Stanley & Patterson, Inc., "Simplex."
Telephone & Elec.Equip.Co. "Pratt Chuck Co."

BRACKETS

Desk Telephone Brackets

Brooks-Follis Elec. Corp.
Stanley & Patterson, Inc., "Imperial."
Sterling Elec. Co., "Equipoise."
Western Electric Co.

Iron Pole Brackets

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Cutter."
Pierson, Roeding & Co.
Western Elec. Co., "Fletcher."

BUILDING CONTRACTORS

Watson, Sidney
Thorpe & Sons, J. T.

BURNERS

Gas Lighting Burners

Edwards & Co.
Electric Goods Mfg. Co., "Advance."
Western Electric Co., "Edwards."

CABINETS

Special Cabinet Work

Krantz, H., Mfg. Co.

Metal Cabinets

Krantz, H. Mfg. Co.

CABLES

Submarine and Lead-Covered

Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A. "Tolma."
Safety Ins. Wire & Cable Co.
Standard Underground Cable Co.
Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

Paper Insulation

Cellen Manufacturing Co.
Western Electric Co.

Telephone Cable

Dean Electric Co.
Kellogg Switchboard and Supply Co.

CARBONS

Arc Light Carbons

Brooks-Follis Elec. Corp. "Siemens."
Reisinger, Hugo "Electra," "Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The "I-T-E." "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
Kierulff Jr. & Co., B. F. "Hartman."
Pacific Electric & Manufacturing Co.
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLAMPS

Ground Clamps.

Belden Manufacturing Co.
Bossert Electric Const. Co.
Chase - Shawmut Co., "Shawmut."

General Electric Co.
Paiste Co., H. T. "Perma-Effect."
Thomas & Sons Co., R.
Weber Elec. Co., H. D.

CLEATS.

Fibre Cleats

Blake Signal & Mfg. Co.
Brooks-Follis Elec. Corp.

Porcelain Cleats

Brooks-Follis Elec. Corp.
General Electric Co.
Pass & Seymour
Standard Electrical Works, "Standard."
Star Porcelain Co. Sears, general sales agent.
Western Elec. Co., "Thomas."

COILS

Armature and Field Coils

Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Deltabeston."
Westghse Elec. & Mfg. Co.

Induction Coils

Electric Goods Mfg. Co.
Kellogg Switchboard and Supply Co.
Partrick,Carter&WilkinsCo.
Western Electric Co.

Spark Coils

Electric Goods Mfg. Co.
Western Electric Co.

COMPOUNDS

Boiler Compounds

Dearborn Drug & Chemical Works
Johns-Manville Co., H. W., "Magic."

CONDUIT

Flexible Conduit

American Circular Loom Co., "Circular Loom."
Sprague Electric Co., "Greenfield."
Telephone & Elec Equip.Co. "Flexduct."

Rigid Conduit

American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct," "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roebling's Sons Co., J. A., "Navalite."
Sprague Electric Co., "Iron Armored."
Telephone & Elec.Equip.Co. "Economy."

Underground Conduit

American Cross Arm Co., "Walworth & Neville."
Johns-Manville Co., H. W., "J-M."
Pierson, Roeding & Co., "Fibre."
Roebling's Sons Co., J. A., "Bituminized Fiber."
Western Electric Co. "Walworth & Neville."

CONNECTORS

Cable Connectors

American Eveready Co., "Bulldog."
Belden Manufacturing Co.
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F., Jr. & Co.

CORD

Flexible Bell Cord

Belden Mfg. Co.
Brooks-Follis Elec. Corp.
General Electric Co.
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Roebling's Sons Co., J. A.
Simplex Elec. Co.
Western Electric Co.

Lamp Cord

Belden Mfg. Co.
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "Paranite."

General Electric Co.
Okonite Co., The, "Okonite."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Roebling's Sons Co., John A.
Safety Ins. Wire and Cable Co.
Simplex Elec. Co.
Standard Und. Cable Co.
Western Elec. Co., "Victor."

Telephone Cord.

Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Dean Electric Co.
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Safety Ins. Wire and Cable Co.
Simplex Elec. Co.
Western Elec. Co., "Victor."

CROSS ARM BRACES.

Benicia Iron Works.
Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co.

CLUSTERS

Fixture Clusters

Benjamin Electric Mfg. Co "Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbell."

CUT-OUTS

Arc Cut-Outs

Bryant Electric Co.
Ft. Wayne Elec. Works.
General Electric Co.

Incandescent Cut-Outs

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
Paiste Co., H. T., "Shaffer," "K. W.," "P. K.," "Taplets."
Perkins Elec. Swch Mfg Co
Weber Elec. Co., H. D. Sears, general sales agent
Westghse Elec. & Mfg. Co

Transformer Cut-Outs

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour
Westghse Elec. & Mfg. Co

DYNAMOS

A. C. Dynamos

Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co.
Western Electric Co.
Westghse Elec. & Mfg. Co

D. C. Dynamos

Electric Appliance Co "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co
Western Electric Co.
Westghse Elec. & Mfg. Co

ELECTRIC NOVELTIES

American Eveready Co "Ever Ready."

ENGINES

Gas and Gasoline Engines

Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Kierulff, B. F., Jr. & Co "American Diesel."
Tracy Engineering Co.
Westinghouse Machine C

Marine Engines

Standard Engineering Co "Engberg."

Steam Engines

Moore & Co., Chas. C.
Henshaw, Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Standard Engineering Co
Tracy Engineering Co., Th
Westinghouse Machine C

FANS

A. C. Portable Fans

Brooks-Follis Elec. Corp.
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Standard Electric Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

D. C. Portable Fans

Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Sprague Electric Co., "Lundell."
Standard Electrical Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

A. C. Ceiling Fans

Brooks-Follis Elec. Corp.
Standard Elec. Works, "Jandus," "Century."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

D. C. Ceiling Fans

Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
General Electric Co.
Sprague Electric Co., "Lundell."
Standard Elec. Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

Exhaust Fans

Brooks-Follis Elec. Corp.
General Electric Co.
Standard Elec. Wks., "M. A. Co."
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co.

FIXTURES

Ceiling, Bracket and Desk Fixtures

Benjamin Elec. Mfg. Co.
Dale Co.

Marine Fixtures

Benjamin Elec. Mfg. Co.
Dale Co.
Electric Appliance Co.
Sterling Electric Co.

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Benjamin Elec. Mfg. Co.
Dale Co.
Johns-Manville Co., H. W., "Linolite."

Stage Fixtures

Chase-Shawmut Co.,"Shawmut."

FUSE MATERIAL

Enclosed Fuses and Fittings

Bryant Electric Co.
Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co., "Union."
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W., "Noark."
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

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Including Service Boxes, Subway Boxes and Junction Cut-Outs for use with enclosed fuses.
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Johns-Manville Co., H. W., "Noark."

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Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co.
General Electric Co.
Pierson, Roeding & Co., "Aluminum."

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General Electric Co
Paiste, H. T. Co., "H. & L."
Weber Elec. Co., H. D. Sears, Gen'l Sales Agent.

Telephone Fuses
Dean Electric Co.
D. & W. Fuse Co.
Kierulff, B. F., Jr. & Co. "Sterling."
Standard Elec. Works "Couch & Seeley."
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GOVERNORS.

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Pierson, Roeding & Co. "Lombard."

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Wire Lamp Guards.
Benjamin Electric Mfg. Co. "Can't Break," "Protectalite."
Hubbell, Harvey
Krantz, H., Mfg. Co.

HANGERS

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Chase-Shawmut Co., "Boston."
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Standard Underground Cable Co., "Nordyke Support."

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Elec. Appliance Co. "American."
General Electric Co.
Johns-Manville Co., H. W. "Electrotherm."
Simplex Elec. Heating Co. "Simplex."
Vulcan Elec. Heating Co. "Vulcan."
Westghse Elec. & Mfg. Co.

HOODS.

Street Hoods
Elec. Appliance Co., "Cutter."
Ft. Wayne Elec. Works.
General Electric Co.
Kierulff, B. F., Jr. & Co. "Cutter."
Western Elec. Co., "Fletcher."

INSULATORS

Glass Insulators
Brookfield Glass Company "Brookfield."
Elec. Appliance Co., "Hemingray."
Pierson, Roeding & Co. "Locke Triple Petticoat."
Roebling's Sons Co., John A., "Knowles."
Standard Electrical Works "Standard."
Western Elec. Co., "Brookfield."

High-Tension Insulators.
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co. "Ohio Brass."
Pass & Seymour.
Pierson, Roeding & Co. "Locke."
Roebling's Sons Co., John A., "Lima."
Thomas & Sons Co., R.
Western Elec. Co., "Thomas."

Porcelain Insulators
General Electric Co.
Johns-Manville Co., H. W.
Pass & Seymour
Pierson, Roeding & Co. "Locke."
Standard Electrical Works "Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Electric Co., H. D. Sears, gen'l sales agent
Western Elec. Co., "Thomas."

Wood Knobs
Blake Signal & Mfg. Co.

INSULATING MATERIAL

Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co. "Di-electric."

Johns-Manville Co., H. W. "Asbestos Wood," "Indurated Fibre," "Vulcabeston," "Monarch," Phoenix," "Electrobeston."
Paraffine Paint Co., Agents "P. & B." Products.
Standard Underground Cable Co., "Ozite."

LAMPS.

Electric Arc Lamps
Brooks-Follis Elec. Corp.
Elec. Appliance Company, "Adams-Bagnall."
Ft. Wayne Electric Works, "Wood."
General Electric Co., "G. E."
Standard Electrical Works, "Jandus," "Boulevard."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

Flaming Arc Lamps
Brooks-Follis Elec. Corp.
General Electric Co., "G. I."
Western Elec. Co., "Victor."
Westghse Elec. & Mfg. Co.

Incandescent Lamps
Brooks-Follis Elec. Corp., "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co "California."
Elec. Appliance Co., "Packard."
General Elec. Co., "Edison," "Lowatt."
Johns-Manville Co., H. W., "Linolite."
Kierulff, B. F., Jr. & Co., "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc. Lamp Co., "Sunbeam," "Regal."
Western Electric Co., "Sunbeam," "Regal."
Westghse Elec. & Mfg. Co. "Westinghouse."

Miniature Lamps.
American Eveready Co., "Ever Ready."

Tantalum Lamps
Bryan-Marsh Co., "Imperial."
General Elec. Co., "Meridian," "Tantalum."
Kierulff, B. F., Jr. & Co., "Excelsior."
Sunbeam Inc. Lamp Co., "Sunbeam."
Western Electric Co., "Sunbeam."

Tungsten Lamps
Brooks-Follis Elec. Corp., "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co., "California."
Elec. Appliance Co., "Packard."
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc. Lamp Co., "Sunbeam."
Western Electric Co., "Sunbeam."
Westghse Elec. & Mfg. Co.

LINE MATERIAL.

Street Ry. Line Material
General Electric Co.
Johns-Manville Co., H. W., "J-M."
Kierulff, B. F., Jr. & Co., "Lord Electric Co."
Pierson, Roeding & Co., "Ohio Brass Co."
Western Elec. Co., "Electrose."
Westghse Elec. & Mfg. Co.

MACHINES

Refrigerating Machines
Vulcan Iron Works

MINING

Mining Machinery
General Electric Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C.
Westghse Elec. & Mfg. Co.
Western Electric Co.

METERS

Ammeters and Voltmeters
American Eveready Co., "Every Ready."
Ft. Wayne Elec. Works, "Wood."
General Electric Co.
Johns-Manville Co., H. W., "Victor Combination."
Western Electric Co.
Westghse Elec. & Mfg. Co.
Weston Elec. Instmt. Co.

Gas Meters
Pacific Meter Co.

Wattmeters
Duncan Elec. Mfg. Co., "Duncan," "Monetary."
Electric Appliance Co., "Sangamo."
Ft. Wayne Electric Works.
General Electric Co.
Johns-Manville Co., H. W.
Weston Elec. Instmt. Co.
Westghse Elec. & Mfg. Co.

MOTORS

A. C. Motors
General Electric Co.
Kierulff, Jr., & Co., B. F., "Ideal."
Standard Electrical Works, "Century."
Telephone & Elec. Equip. Co., "Holtzer-Cabot."
Western Electric Co.
Westghse Elec. & Mfg. Co.

D. C. Motors
Elec. Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co.
Standard Electrical Works, "Century."
Telephone & Elec. Equip. Co., "Holtzer-Cabot."
Western Electric Co.
Westghse Elec. & Mfg. Co.

MOULDING

American Circular Loom Co., "Lutz."
Johns-Manville Co., H. W., "Electrobestos."

PAINTS.

Insulating Paint
Kierulff, B. F., Jr. & Co., "Di-electric."
Paraffine Paint Co., The, "P & B."
Standard Underground Cable Co., "Ozite."

PINS

Iron Pins
Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Hubbard."
Pierson, Roeding & Co., "Locke."
Roebling & Sons Co., J. A., "Lima."
Thomas & Sons Co., The R. "Lee."
Western Electric Co., "Lee" "Fletcher."

Wood Pins
Kierulff, B. F., Jr. & Co.
Pierson, Roeding & Co., Eucalyptus and Locust.

PIPE.

Iron and Steel Pipe.
[illegible] Co., The

PLUGS.

Attachment Plugs.
Benjamin Elec. Mfg. Co.
Brooks-Follis Elec. Corp.
Bryant Electric Co.
Electric Goods Mfg. Co., "Howes."
General Electric Co.
Hubbell, Harvey.
Paiste Co., H. T., "Paiston."
Pass & Seymour.
Stanley & Patterson, Inc., [illegible]

Flush Plugs
[illegible] Corp.
[illegible]
[illegible] Co., The
[illegible] Electric Co.
Hubbell, Harvey.
Pass & Seymour.
Stanley & Patterson, Inc., "Simplex."

Stage Plugs
Chase-Shawmut Co., "Cushing."
General Electric Co.
Stanley & Patterson, Inc., "Fielding."
Standard Electrical Works, "Kliegle."
Western Elec. Co., "Krueger."

POCKET FLASHLIGHTS.

American Eveready Co., "Ever Ready."

POLES.

Iron and Steel Poles.
Benicia Iron Works.
California Pole & Piling Co.
Kierulff, B. F., Jr. & Co., "Tripartite."
Pierson, Roeding & Co.

Wood Poles
California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Sterling Electric Co.
Western Electric Co.

PUMPS.

Centrifugal Pumps
Goeritz & Co., O. C.

Turbine Pumps
Goeritz & Co., O. C.

PUSH BUTTONS.

American Eveready Co., "Nosety."
Brooks-Follis Elec. Corp.
Edwards & Co.
Electric Goods Mfg. Co.
Partrick Carter & Wilkins Co.
Pass & Seymour.
Western Electric Co., "Edwards," "Midget, Jr.," "New Mite."

RAIL BONDS.

Chase-Shawmut Co., "Shawmut."
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Thomas."
Pierson, Roeding & Co.
Roebling's Sons Co., J. A.
Westghse Elec. & Mfg. Co.

RECTIFIERS.

General Elec. Co., Mercury Arc.
Westghse Elec. & Mfg. Co., "Cooper-Hewitt."

RHEOSTATS

Field Rheostats
Ft. Wayne Elec. Works.
General Elec. Co.
Simplex Elec. Heating Co.
Standard Electrical Works, "Union."

Motor Starters
Ft. Wayne Elec. Works.
General Elec. Co.
Standard Electrical Works, "Union."
Westghse Elec. & Mfg. Co.

SEARCHLIGHTS

Ft. Wayne Elec. Works.
General Elec. Co.
Std. Elec. Wks., "Engberg."

SHADES

Benjamin Elec. & Mfg. Co.
Dale Co.
Elec. Appliance Co., "Cutter."
Holophane Co.
Hubbell, Harvey.
Pass & Seymour.
Western Electric Co., "Matten."

SOCKETS

Including all classes of Sockets and Receptacles.
American Eveready Co., "Ever Ready."
Benjamin Elec. and Mfg. Co., "Twin Socket," "Benjamin W. P. Socket."
Bryant Elec. Co., "Bryant."
General Elec. Co., "Edison."
Hubbell, Harvey, "Hubbell Socket."
Johns-Manville Co., H. W., "Moulded Mica W. P. Sockets."
Paiste Co., H. T., "Fielding" and "Holoshade."
Pass & Seymour.
Perkins Elec. Swch. Mfg. Co.
Stanley & Patterson, Inc., "New Code." W. P.
Weber Electric Co., H. D. Sears, gen'l sales agent.

SOLDERING MATERIAL

Self-Fluxing Solder
Belden Manufacturing Co.
Dean Electric Co., "1900."
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "Dielectric."
Western Electric Co.

Soldering Paste
Belden Manufacturing Co.
Blake Signal & Mfg. Co., "Aluminum Tube."
Chase-Shawmut Co., "Red E."
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F., Jr. & Co., "Dielectric."
Standard Electrical Works, "Standard."
Western Elec. Co., "Hawthorne."

Soldering Salts
Belden Manufacturing Co.
Western Elec. Co., "Hawthorne."

Soldering Sticks
Belden Manufacturing Co.
Western Elec. Co., "Hawthorne."

STREET CARS.

Pierson, Roeding & Co., Brill.

STAPLES

Insulating Staples
Blake Signal & Mfg. Co.
Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co., "Blake."

SWITCHES

Pump Switches
Krantz, H., Mfg. Co.

Ceiling Switches
Krantz, H., Mfg. Co.

Door Switches
Edwards & Co., "Eco," "Langen."
Perkins Elec. Swch. Mfg. Co.
Standard Electrical Works, "M. & M."
Telephone & Elec. Equip. Co., "H. & H."
Western Elec. Co., "Eco," "Langen."

Snap Switches
Arrow Elec. Co., "Arrow E."
Cutter Co., The, "C-S."
Dale Co.
General Electric Co.
Krantz Mfg. Co., H.
Perkins Elec. Swch. Mfg. Co.
Standard Electrical Works, "M. & M."
Telephone & Elec. Equip. Co., "H. & H."

Knife Switches
Chase-Shawmut Co.
General Electric Co.
Krantz Mfg. Co., H.
Paiste Co., H. T.
Perkins Elec. Swch. Mfg. Co.
Std. Elec. Works, "Barkelew."
Western Electric Co.
Westghse Elec. & Mfg. Co.

Oil Switches
Pacific Electric & Manufacturing Co.

Pendant Switches.
General Electric Co.
Pass & Seymour.
Perkins Elec. Swch. Mfg. Co.
Standard Electrical Works, "Jandus."

Pole Top Switches
Pacific Electric and Manufacturing Co.

SWITCHBOARDS

Power Boards
Cutter Co., The
Ft. Wayne Elec. Works.
General Electric Co.
Krantz Mfg. Co., H.
Paiste Co., H. T., "Panelettes."
Standard Electrical Works, "Barkelew."
Western Electric Co.
Westghse Elec. & Mfg. Co.

Telephone Boards
Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Elec. Goods Mfg. Co., "Annunciaphone," "Rotokoll."
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Switchboard and Supply Co.
Standard Electrical Works, "Couch & Seeley."
Western Electric Co.

TAPE

Belden Manufacturing Co., "Century."
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "Eaco."
General Elec. Co., "Paragon."
Johns-Manville Co., H. W., "Magnetto," "Fibroid," "Nigrite," "J.-M."
Kierulff, B. F., Jr. & Co., "Imperial."
N. Y. Insulated Wire Co., "Grimshaw," "Competition."
Okonite Co., The, "Okonite," "Manson."
Paraffine Paint Co., The, "P. & B."
Standard Electrical Works, "Standard."
Sterling Elec. Co., "Bear," "Sequoia."
Western Electric Co., "Victor," "Amazon."

TELEPHONE EQUIPMENT

Dean Electric Co.
Electric Appliance Co.
Electric Goods Mfg. Co.
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Standard Electrical Works, "C & S."
Telephone & Elec. Equip. Co., "Stromberg-Carlson."
Western Electric Co.

TOOLS.

Automobile Tools
American Eveready Co., "Ever Ready."

Construction Tools
Kierulff, B. F., Jr. & Co.
Klein & Sons, Mathias.

Wire-Cutting Pliers
Klein & Sons, Mathias.

TOWERS (STEEL).

Benicia Iron Works.
Kierulff, B. F., Jr. & Co., "Tripartite."
Pierson, Roeding & Co.

TRANSFORMERS

American Transformer Co., "American."
Duncan Elec. Mfg. Co.
Elec. Appliance Co., "Packard."
Ft. Wayne Electric Works, "Wood."
General Electric Co.
Western Elec. Co., "American."
Westghse Elec. & Mfg. Co., "Westinghouse."

TURBINES

Steam Turbines
General Elec. Co., "Curtis."
Western Elec. Co., "Rateau."
Westghse Machine Co., "Westinghouse-Parsons."

Water Turbines
Goeriz & Co., O. C.
Pelton Water Wheel Co., "Pelton-Francis."

TELEGRAPH INSTRUMENTS.

Western Elec. Co.

WIRE

Aluminum Wire.
Pierson, Roeling & Co.

Annun's and Office Wire
Belden Manufacturing Co.
Electric Appliance Co., "Ansonia."
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Co.

Armored Wire
Sprague Electric Co., "Greenfield."
Standard Und. Cable Co.

Asbestos-Covered Wire.
Belden Manufacturing Co.
D. & W. Fuse Co., "Deltabeston."
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Heany."
Safety Ins. Wire & Cable Co.
Western Elec. Co., "Deltabeston."

Bare Copper Wire
Belden Manufacturing Co.
Roebling's Sons Co., J. A.
Kierulff, Jr., & Co., B. F.
Phillips Insulated Wire Co.
Pierson, Roeding & Co.
Standard Und. Cable Co.
Telephone & Elec. Equip. Co., "American Elec. Works."

Enameled Wire
Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Hawthorne."

Iron Wire
Belden Manufacturing Co.
Roebling's Sons Co., J. A.

Magnet Wire
Belden Manufacturing Co.
D. & W. Fuse Co., "Deltabeston."
Electric Appliance Co., "Ansonia."
Kellogg Switchboard and Supply Co.
Kierulff, Jr. & Co., B. F.
Roebling's Sons Co., J. A.
Standard Und. Cable Co.
Western Electric Co., "Hawthorne."

Rubber-Covered Wire.
Belden Mfg. Co.
Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Indiana Rubber & Insulated Wire Co., "Paranite."
Kierulff, B. F., Jr & Co., "National."
Roebling's Sons Co., J. A.
N. Y. Insulated Wire Co., "Grimshaw," "Raven Core."
Okonite Co., The, "Okonite."
Phillips Insulated Wire Co., "Parac."
Safety Ins. Wire & Cable Co.
Simplex Electric Co., "Simplex," "Climax."
Std. Und. Cable Co., "Tip Top," "Marsh," "Sterling."
Western Electric Co., "Habirshaw," "Parac."

Weatherproof Wire.
Elec. Appliance Co., "O.K."
General Elec. Co.
Kierulff, B., F., Jr. & Co., "Chicago."
Okonite Co. The, "Candee."
Phillips Insulated Wire Co., "O. K."
Roebling's Sons Co., J. A.
Simplex Elec. Co., "T. Z. R."
Standard Und. Cable Co.
Telephone & Elec. Equip. Co., "American Elec. Works."
Western Electric Co., "O. K."

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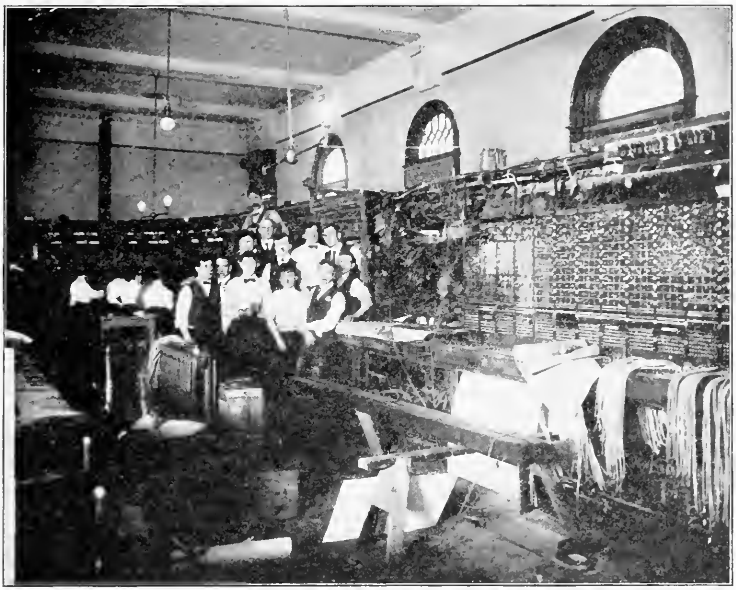
RAPID SWITCHBOARD RECONSTRUCTION

A fire, which probably started near the cord terminals in the first position of the "A" board in the main office, Portland, Ore., March 20th, entirely destroyed the first, and part of the second section of the switchboard. The fire was first discovered by one of the night switchboardmen at about 5 a. m. An alarm was immediately turned in and the fire department arrived on the scene promptly with the chemical engine. The fire was finally extinguished after it had burned its way through to the top of the top bank of multiples. The liquid extinguishers also wrought considerable damage to cables and jacks which were not touched by the flames.

The fire occurred in nearly the most vital point of the multiple, as the only place where it could possibly have rendered a greater havoc would have been in the T splice, where the "A" and "B" multiples are spliced to the cable terminating on the intermediate distributing frame. As it was, the damage from fire and extinguisher liquid combined, crossed up practically all the lines in the board, which necessitated the opening up of the main battery fuses and leaving them open until the fuses had been disconnected from the relay bays and the line lamps. This, of course, rendered the "A" and "B" boards both entirely useless.

At exactly 6:15 a. m. work was started on cutting away the multiple jacks from the cables in order to clear the lines from crosses and grounds. This was completed about three hours later and relay bays and line lamps were again fused up. While the work of cutting away the damaged jacks and cables was in progress, other men began to splice out the outgoing trunk multiple so that, when the damaged multiple had been cleared, service was restored to subscribers desiring connection with East Tabor, Woodlawn and Sellwood offices. By that time temporary trunks had also been established from the "A" to the "B" boards so that, at about 3 p. m., partial incoming service was restored even to the main subscribers.

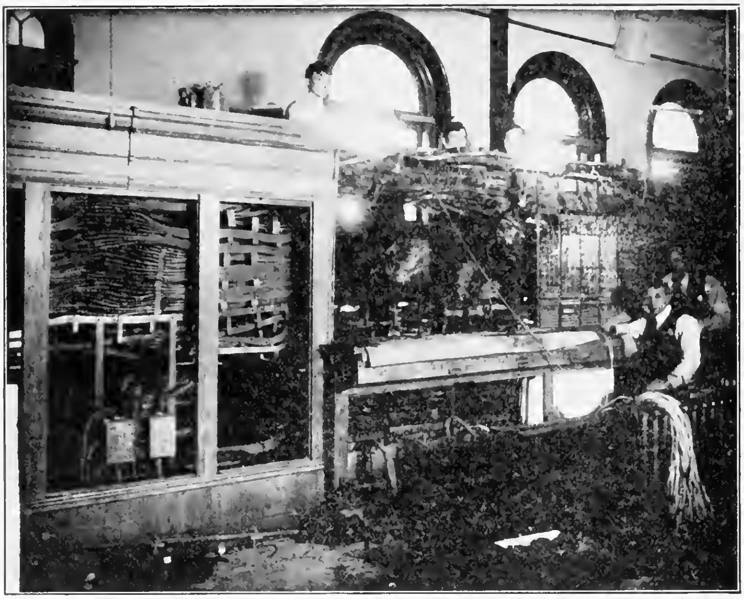


Portland (Ore.) Fire. Face of Switchboard

The work of splicing together the multiple cables

at the burned section, in order to restore complete service, was then commenced. This was naturally slow work, owing to the limited space in which the men had to work. The work was also retarded as a majority of cables in the front layer of the multiple were burned in half; others were found to be soaked in liquid which necessitated two splices in each of these cables. As the splicers were progressing other men were forming cables and others making continuity tests of finished splices from the "A" to the "B" boards. Others were engaged in making voltmeter tests for leaky cables and clearing trouble. It was also necessary to transfer 440 answering jacks to other panels and establish temporary testing outfits. The men worked in three shifts. Some, however, worked from 12 to 14 hours, expressing their willingness, as well as desire, to do so in order to restore connections. Fairly good service was given all day Sunday, March 21st, and, though somewhat congested, owing to the insufficient number of trunks, service on Monday was practically restored to the 13,500 subscribers whose service had been crippled.

On the morning of Wednesday, March 24th, there were but 48 lines plugged up on the hospital position. A complete voltmeter test had been made on the night previous, the results of which indicated a few lines as showing escape, which, however, did not interrupt the service. This remarkable restoration was due to the efficient co-operation of all departments, and the officials of the company were the recipients of many commendatory words from the press and public. Through the courtesy of the Pacific T. & T. Co. we reproduce photographs which will give the reader an idea of the difficulties encountered.



Portland (Ore.) Fire. Face of Switchboard

WHY TELEPHONE COMPANIES CHARGE MORE FOR SERVICE IN LARGE THAN IN SMALL EXCHANGES.

Nearly every one is familiar with the fact that telephone companies charge more for service in large cities than in small cities and towns, but many do not understand why this is necessary, and some believe that the charges for service should be reduced, rather than increased, as the telephone exchange grows in number of subscribers.

The general public assumes that the telephone furnished each subscriber is the unit of cost of the commodity which the telephone company is selling. It is natural that it does not understand why the company charges more for telephone service in an exchange with a large number of telephones than in an exchange with a small number, and asks why the telephone business differs in this respect from practically all other businesses. This question, while quite generally propounded, is asked under a misapprehension or without due consideration of the real facts.

It can be demonstrated that, as an exchange grows, the cost of furnishing under any particular class of service the unlimited use of the entire system, or plant, to each patron increases, and that an increase in the charge made therefor is necessary. It can also be demonstrated that at the same time the cost per unit has decreased, and that the charges based on any reasonable unit of measurement will show a reduction.

If an exchange with a small number of subscribers the cost of the plant is not very great and its construction is simple. The switchboard is inexpensive and easily maintained, not requiring the service of an expert. The poles are small, and the cables, if any,

are not only small, but of short length. No underground construction is necessary. As the exchange increases in size, these conditions gradually change, and in due course of time it is necessary to have underground conduits, underground cables, multiple switchboards, power plants, and supervisory apparatus of many kinds, and the employment of experts at a greater rate of pay becomes necessary.

To illustrate: A switchboard for an exchange of three hundred lines or less can be purchased at from $1.50 to $3.00 per line, while a switchboard with a maximum capacity of ten thousand lines, but equipped for only six thousand lines, and with fifteen sections installed, would cost about $120,000 or $20 per line, and one fully equipped for ten thousand lines and twenty-five sections installed, which would be necessary to operate that many lines, would cost about $250,000, of $25 per line. Thus it will be seen that on this one item alone the cost in a very large exchange is ten times greater than in a small exchange. This is only one item, and illustrations could be made comparing the cost of underground conduit and cable, underground distribution in the central part of the city, interior block distribution in the suburbs, the cost of real estate, of taxes, of salaries and wages, of damage and compensation, of bad debts, forced reconstruction or replacement due to abnormal growths or requirements of the city. In fact, practically all items of furnishing service in a large city increase as compared with the cost of similar items in a small town, and, when the unlimited use of the entire plant is furnished at a flat rate, this rate must necessarily be larger per station as the city grows and as the exchange grows, and it should not be overlooked that the value of the service to the patron increases just as rapidly.

The telephone company does not sell the telephone on the wall, in the office, or the residence, neither does it rent it to the subscriber. In any exchange where there is a flat rate for the unlimited use of the entire plant, the company places this plant, consisting of switchboards and central office apparatus, underground conduit, cable, poles, wires, etc., all at the subscriber's disposal, and places the instrument in his office or residence in order that the subscriber may be able to avail himself of the different uses of the plant, as his necessities may require.

Assuming that there are two miles of wire per telephone as a fair basis, an exchange of 2,500 telephones will require 5,000 miles of wire to connect them with the central office. If the charge for a special line telephone is $5 per month, it will be seen that the rate charged for the use of the wire is $1 per month per thousand miles of wire. If this exchange grows until there are 5,000 telephones connected with it, and if the average amount of wire for each telephone is still two miles (as a matter of fact the average length of wire for each telephone will have increased), it will require 10,000 miles of wire to connect all of the telephones with the central office. If the rate is still $5 per month for a special line telephone, the rate charged is 50 cents per month per thousand miles of wire, or just 50 per cent as much as was paid for the service when there were only 2,500 stations connected with the exchange. If the same exchange increases to 8,000 telephones and still has an average of two miles of wire per telephone (which is less than will be the case in actual practice), there will be 16,000 miles of wire, and, if a rate of $6 per month is charged for a special line telephone, the subscriber will pay only 37½ cents per month per thousand miles of wire, or only three-eighths as much as he paid when the exchange had only 2,500 telephones in operation.

If the cost of the telephone plant is taken as a basis for making charges and $1,000 is considered as the unit, upon this basis the charges continually grow less and less per unit as the exchange grows. In other words, the cost of the service to each subscriber is not increased in the same proportion as the investment in the plant is increased.

Consider the number of telephones with which the subscriber can talk for an unlimited flat rate per month as the basis of charge for the service. Assuming 5000 telephones and a charge of $5 per month for special line service, it will be seen that the charge is $1 per month for each 1,000 telephones with which the subscriber can be connected. With 10,000 telephones and a flat rate of $6 per month, the charge would be 60 cents per month per 1,000 telephones, or 40 per cent cheaper than the rate charged when there were only 5,000 telephones.

Another unit for computing the charge made and one accepted by many experts, is the message mile; that is, the transmission of one telephone message for a distance of one mile. In a small town, with a small number of subscribers, say 100 or less, the distance between each telephone is not very great and the distance traversed by each conversation is small. On account of the small number of people with whom the subscriber can talk in a small exchange, the number of calls per telephone per day is also small. When the second one hundred telephones are added, each of these subscribers has the opportunity to talk to the first one hundred and also to ninety-nine of the second one hundred. As the exchange grows, so does the town or city, and, in a large city with a large number of telephones, the subscriber is enabled to talk to many people at a very considerable distance. In this way the average number of miles traversed by a telephone conversation is, in a large exchange, much greater than in a small exchange. Statistics from a number of small exchanges, as well as a number of large exchanges, of one of the telephone companies of this country indicate that the average length of wire for each subscriber in a small exchange is less than 1.2 miles, while in an exchange of 10,000 or 12,000 telephones the average is 3.4 miles of wire.

In a given city the average length per line is 2.3 miles. The average length of line used for each telephone conversation is twice this figure, or 4.6 miles. The average number of daily conversations per telephone is eight, including Sundays. This figure multiplied by the length of line used for each conversation, 4.6 gives 36.8 message miles per telephone per day, of 1,104 message miles per telephone per month. The average rate per telephone in this exchange is $4.24 per month. This gives a cost per message mile in this exchange of thirty-eight one-hundredths of a cent.

On the other hand, an average of ten small exchanges of the same company, chosen at random, having an average rate per line of $2.28 per month, shows an average length per line of .8 miles, and the average length of line per conversation is twice this, or 1.6 miles. The average number of daily conversations at these ten exchanges is 4.1 per telephone, including Sundays. This multiplied by the length of line per conversation, 1.6, gives 6.56 message miles per line per day, or 196.8 message miles per line per month.. The subscriber pays $2.28 per month, as stated above. This gives a cost per message mile to the subscriber of 1.16 cents. Compare this with .38 cents for the city above referred to in which a large exchange is operated. It is seen that the average cost per message mile to the subscriber in the larger exchange is only 35 per cent of what it is to the subscriber in the smaller exchange, although the average rate per station per month at the smaller exchange is scarcely more than one-half that at the larger exchange.

Unfortunately, in the telephone business there are a large number of fixed charges irrespective of the amount of service performed, and the most of these tend particularly to increase with the size of the exchange, so that it is impossible for a telephone company to sell service at large exchanges in small enough quantities to make the initial price as low as in a very small exchange, even when a specific charge is made for each message over a certain number.

Among these increasing costs are investment, operating, maintenance, engineering, discontinuances, taxes, rent, light and labor. It is also necessary to provide a large proportion of facilities in advance of demand at large exchanges, owing to the fact that in small towns the degree and direction of growth can be much more accurately predicted.

The question of the value of the service to the subscriber is interesting and important. In no other business does this value play so small a part in the mind of the purchaser. Usually, price depends upon a combination of cost to seller and value to buyer. In the real estate business it depends almost wholly on value to buyer. Recent computations show that, if one-half of all telephone connections be assumed to be of a social nature and useless from an economic standpoint, and if it be further assumed that the average value of the time of the telephone user is $900.00 per year and the average time saved for one man twenty minutes per business message (all of these being conservative assumptions), then the average value per telephone to the user is more than five times the average revenue per station to the telephone company. This refers only to the value of the time saved and added to the productive force of the country, and does not include any direct monetary saving, such as messenger fees, car-fare, etc.

The great excess of value over price is more marked at the larger exchanges than at the smaller. The average value of the time of the user is greater in a large city than in a small town, and the amount of time saved by each message is greater, due to the greater distances to be traversed. Conservative figures place the average value of the time saved per business message at ten small exchanges at three cents and at ten large exchanges at twelve cents. These figures, dealing with values only, assign no value to the social and trivial conversations, estimated at one-half of the whole number, although such conversations have some value to the user, which is greater at a large exchange than at a small one, and the cost of handling a conversation is the same to the company, irrespective of its value.

The value of the service to the purchaser becomes important as an element of rate making only when, the average rate necessary to run the business at an adequate profit having been determined, the question arises as to the proper differentials to produce this average rate, to be made between the charges for the different classes of service (business or residence; special line, duplex, or party line; unlimited or message rate, as the case may be). It is a physical impossibility to state the exact relative cost of each of these classes of service. Even if an accounting system were practiced which was sufficiently complex to differentiate the direct cost of each, there would be no reasonable method of apportionment of the fixed and the general charges of the company. In determining these differentials, therefore, recourse is taken to the relative value of the service of each class to the user; and since this can be told within narrow limits from the results of past experiments, taken in connection with the present known conditions, the result is an equitable and fair distribution of charges, leaving them well within the value to the user, and imposing no undue burden upon any one class of business.

THE OTHER SIDE.

During the past few years criticism has been rampant in connection with corporations and corporation management. It is true that in some instances investigation has disclosed irregularities deserving of prompt and effective correction, but as yet it has been found impossible to eliminate the weaknesses of human nature either in individual or corporate activities. The thoughtless reader who has formed his opinions from the headlines of yellow newspapers has possibly come to a belief that a few individuals in the financial world, through combination and unscrupulous methods, are forging shackles of industrial serfdom for all time upon "the people." The sensational space writer, the muck-raker and the politician with his affection for "the people," can certainly claim a degree of doubtful satisfaction in that they have brought about certain results, and it is well to consider who has been affected thereby. The corporation has been found to be the most convenient form of business arrangement. Results are possible under combination which cannot be otherwise attained. Shareholders, busy in their own limited spheres of action, must of necessity entrust the investment of their accumulations to others. Two and one-half million investors own the corporations of America. One-half the workers of this country whose compensation is received in the form of wages or salaries draw these incomes through organized industries. The close competition of the business world, the demand for executive ability and economy of management render necessary a centralization of control, but statistics show that this means anything

but a centralization of ownership. It is estimated that the ownership of the banks of this country is divided among 400,000 shareholders. Through the life insurance companies with their millions of policy holders and the banks with their millions of depositors, it is a safe assumption that over 15,000,000 people, not directly interested in corporate securities, are indirect participants in corporation profits on account of the investment of savings in these securities, which represent for the most part the accumulations of individual self-denial, thrift and enterprise, and which in great degree constitute the protection of the helpless and dependent.

It is the corporation which goes forward in the new country, and villages, homes, churches, schoolhouses and new forms of employment follow. It is well to remember that corporations cannot carry out great improvements without the sale of their stock and bonds. Earnings are not sufficient for extensions of magnitude. Capital is timid and in the face of reckless or ill-considered legislative interference, actual or threatened, will avoid these securities. Continuous agitation retards development and removes initiative. Depression and idleness follow. Mr. Theodore P. Shonts is authority for the statement that contemplated improvements in railroad work involving the expenditure of hundreds of millions of dollars have been recently abandoned on account of the spirit which seems to have taken possession of those whose duty it is to carefully consider proposed legislation. Men will not undertake tasks involving ability, enterprise, resource and patience when at the end they have nothing to expect but harsh treatment thinly disguised as "regulation" amounting oftentimes to practical confiscation. There is no opposition to such regulation as the public welfare may require, but regulation should also mean protection of legitimate operations. It should not be a cloak for unwarranted legislative action which assumes that enterprise and the possession of property are crimes, and which in truth is but the reflection of the whims and jealousies of the envious, the lazy and the discontented. Publicity and not concealment is the policy of the intelligently managed corporation. The average citizen who gains his livelihood through the corporation or industries dependent upon its prosperity, or, being an indirect beneficiary from its operations, joins in the unthinking criticism of the ignorant or malicious, is in the same category as that intelligent individual who seated on the limb of the tree, sawed it off between himself and the trunk.—Ex.

U. S. Government wireless stations on the Pacific Coast are maintained at Colon, Panama; Farallone Islands, Cal.; Mare Island, Cal.; Pt. Arguello, Cal.; Table Bluff, Cal.; Point Loma, Cal.; Puget Sound, Wash.; Cape Blanco Ore.; North Head, Wash.; Tatoosh Islands, Wash.; Nome, Alaska; Cordova, Alaska; Circle City, Alaska; Fairbanks, Alaska; Wrangell, Alaska; Sitka, Alaska; Ft. Egbert, Alaska; St. Michaels, Alaska; Ft. Gibbon, Alaska; Petersburg, Alaska; Circle City, Alaska; Zamboanga, P. I.; Cavite, P. I.; Island of Guam; Jolo, P. I.; Oahu, Hawaii; Malalong, P. I.

THE DYNAMO AS A LOUD SPEAKING TELEPHONE.

Some interesting experiments have been recently conducted by Professor W. Peukert on sound reproduction according to the German press. As a consequence he has designed a simple and effective form of receiver which is remarkable for its loud speaking qualities. He found first that a ring core,

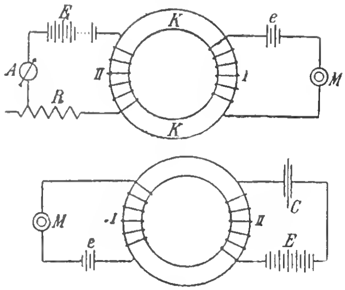


Fig. 1.

consisting of soft iron and surrounded by a winding in series with an ordinary microphone circuit, acted as a telephone receiver. Its loudness was materially increased if a separate winding was added so as to subject the iron to a constant magnetic force, as shown in Fig. 1.

Fig. 2 shows a straight soft iron core, wound with the coil for the microphone circuit and placed between the poles of a permanent magnet, the permanent magnet producing the constant magnetic action necessary. All of the iron particles forming the

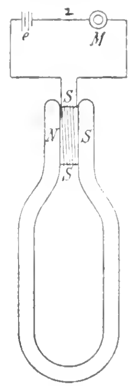


Fig. 2.

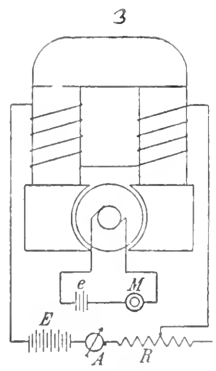


Fig. 3.

closed magnetic circuit vibrate and thus reproduce sound without the usual distortion of the ordinary vibrating membrane.

Fig. 3 shows the microphone circuit in series with the armature winding of a dynamo through its brushes. Separate batteries regulate the resistance and so excite the magnets to the necessary strength. Similarly, an alternating current transformer can be made to act as a receiver by connecting one winding to the microphone circuit and the other to the exciting battery.

ON LIGHTNING ARRESTERS.

Discussion by members of the San Francisco Section of the American Institute of Electrical Engineers of paper on this subject by Mr. A. G. Jones as published in the JOURNAL OF ELECTRICITY, POWER AND GAS of May 1. The following took part in the discussion:

C. W. Burkett, Chief Engineer Pacific Telephone and Telegraph Co., Chairman.

S. J. Lisberger, Engineer of Distribution, Pacific Gas & Electric Co.

S. B. Charters, Department of Electrical Engineering, Leland Stanford Jr. University.

A. J. Bowie, Jr., Consulting Engineer, San Francisco.

A. G. Jones, Sales Engineer, San Francisco office General Electric Co.

F. V. T. Lee, Assistant to President Pacific Gas & Electric Co.

J. W. White, Sales Engineer, Fort Wayne Electric Works, San Francisco.

C. W. Hutton, Engineer of Operation and Maintenance, Great Western Power Co., Sacramento, Cal.

H. W. Crozier, Engineer, San Francisco office of Sanderson & Porter.

C. F. Adams, Assistant Electrical Engineer, Pacific Gas & Electric Co.

S. J. Lisberger: Mr. Jones has given us a very interesting paper on a subject that is of more than ordinary importance. It is to be regretted that the name of the apparatus has been limited to the use of the word "lightning," as one of the most important functions of the electrolyte arrester today is the protection of systems against surges other than those from lightning. I recall a very interesting case in an eastern city, where they had no troubles from lightning—their lines were entirely underground. They have in the circuit I think some 170 miles of cable.

The reactance of the induction regulator in series with the capacity of the cables brought about very serious troubles from surges that in effect seemed to pile up at the end turns of the regulator voltage to such a high extent that it would puncture the regulator windings. This was caused not only by "shorts" in the cable, but "shorts" to ground. They found this condition by taking oscillograph records, and watching results of shorts and grounds artificially produced.

With the hope of finding a solution for the trouble encountered, they put the electrolyte arrester on their system and again observed conditions. They found that great relief was obtained from its use, and, in fact, enough protection afforded by the device in question to actively discharge the high potential from line to ground. A full description and oscillogram curves will be found in the Proceedings of the Association of Edison Illuminating Companies, issue of 1908.

Speaking of the use of this type of arrester as a protection against surges, it would find wiser application were it commercially developed at the present time to be connected directly to the line without the use of an air gap; as any device acting on the safety valve principle, and free from the uncertainties introduced by the air gap, would be a valuable addition to a protective system. The disadvantage of the arrester without the gap is the electrolyte heats, causing the oil to boil over, and renders the apparatus inoperative.

S. B. Charters: In connection with the actual operation of the cell itself, I would like to say, most of my work has been done on a rectifier. Now the first point I wish to make is in regard to the critical voltage. Mr Jones has stated it to be 420 volts. That is true for the electrolyte he has used, but it will vary widely with different electrolytes. In a number of experiments with five electrolytes, the last had a critical voltage of 65, and the current had risen to ten times the leakage current, and at that time I decided to cut it off. The highest value ran to 594 volts without reaching the critical value of ten times the leakage current. So the critical value you have in such an arrangement is a function of the electrolyte.

The second point I wish to make is the thickness of this film, which does the actual rectifying. The film itself is extremely thin, and forms on the aluminum cells as soon as the current is applied. When the cell is first applied to the circuit there is a rush of current, which lasts until the film builds up. Finally it dies down and reaches a steady value. I found at 110 volts the film thickness was about three wave lengths of sodium light. It would stand safely 110 volts. As he says, that thickness will vary. Starting with a certain voltage, there is a certain thickness of film. As the voltage increases, the film thickness increases with it, and the current drops again. Decreasing from the voltage a similar performance takes place. In the electrolytes there was a continual dissolution of the film in the electrolyte. If the cell on the circuit be operating satisfactorily and then the current be cut off for a while—say 24 hours—there will be a serious dissolving of the film, so when the current is put on again there is a rush of current. I understand that has been overcome in the lightning arrester by the use of a suitable electrolyte.

The action is a molecular one taking place in the film. The critical point can be noted in two ways: By watching the ammeter, and also by the commencement of sparking, showing that the film is no longer able to stand the voltage. On a voltage slightly above the critical value small bits of the film are actually torn away by the stresses. As soon as the voltage falls below the critical value again, those small flaws are repaired.

As Mr. Jones said, if the cell is left on the line, the continual action of the leakage current will gradually heat it; and in the work I did I found between 65 and 75 degrees centigrade the action largely ceases. It recedes as it goes up, and about that point it becomes ineffectual—at least for rectifying work. About that neighborhood the tendency is for the film to become weakened in some way, and gradually to permit the passage of current.

The apparatus is self-restoring as soon as the surge goes off; and aside from the one difficulty of heating it seems to me it is a thoroughly admirable addition to our list of apparatus for lightning protection.

A. J. Bowie Jr.: With reference to the desirability of leaving an electrolytic arrester on the circuit, it appears to me it is undesirable rather than desirable; in other words, it is far better to use the gap in series with it than to allow waste of current, which must ensue on a 60,000 volt line. It was stated a little while ago the leakage was one ampere at 60,000. That would represent on a three-phase line probably 100 kilowatts lost. This is a matter which could hardly be allowed under the circumstances. With reference to the electrolytic arrester, although it has many valuable properties, the fact that it requires attention is rather a serious drawback; and any arrester which needs to be looked after is undesirable in some ways.

Now with regard to the action of Horn arresters. A horn arrester, if incorrectly designed, is certainly not suitable, as difficulty will be experienced in extinguishing the arc. On the other hand, properly designed horn arresters have not shown the difficulties which have been attributed to them; in other words, they don't show the abnormal rise in voltage, and it is not necessary to extinguish the arc in the same half cycle in which it starts. There is no form of lightning apparatus which is so little damaged as the horn arrester. In the multigap arrester if the discharge lasts for much over half a cycle, or continues for some while, a flow of metal will result, which will fuse the cylinders. This does not take place in the horn arrester, and therefore it is not essential to extinguish the current immediately. The experience of many companies, including the Niagara and Ontario, has been very favorable to horn arresters; but the arrester must be

designed with proper resistance. It is one of the essential points of an arrester, however, that there must be a path to ground free from resistance if the arrester is to protect against all kinds of conditions. The horn arrester may be provided with a path direct to ground, in addition to having resistance in certain other paths. This has been done in some cases I have mentioned, and results have been more satisfactory; in fact the resistances seem to withdraw the current from the gaps, which they shunt just as they do in a multi-gap arrester.

A. G. Jones: I would like to say a word about the attention required by arresters. I do not exactly agree with Mr. Bowie in saying that any arrester which requires attention is undesirable. On the other hand, I think it is extremely desirable that lightning arresters, like any other electrical apparatus, should have attention. That is just the cause of the trouble and a great many damaging results, due to the use of multi-gap arresters. The station attendants will put the multigap arresters off in a corner, let them become covered with dust, a little damp air comes along, and under high voltages this dust which is damp is a comparatively good conductor. The results are you have a short circuit the first time you have a discharge. Then the arrester is blamed for its bad behavior; and I do not think that this is just, because a lightning arrester, like any other device, requires attention.

S. J. Lisberger: If the company could protect its system at the expense of a small cost of current, it would be a very valuable addition to the system. That the arrester has some faults in its present state of development, in regard to the attention that must be given to it, is a point which cannot be argued. There is however one great advantage of it over the multi-gap arrester, and that is the varying atmospheric conditions which affect the multi-gap arrester. If you can eliminate dust and dirt and all moisture conditions, as compared to an arrester which is under oil and not affected by those conditions, then you have a very superior type of apparatus.

F. V. T. Lee: The horn arrester has not been fully appreciated by the people in the East. In the early days we tried lots of the multi-gap type out here. The California Gas and Electric Corporation at one time, and their predecessors had to put up buildings sometimes very nearly as large as the station to accommodate the arresters, and after a moderate discharge, even if they did not short circuit it was generally necessary to cut them out to clean up the debris and install new units. At this period we had a great deal of trouble with lightning out here, particularly up in the mountains on the old Nevada County circuits, and many devices were tried to overcome this trouble. The most effective remedy was obtained by increasing the insulation of the apparatus, and since the advent of good insulation the trouble has not been a very real one with us. The horn arrester came in after the non-arcing metal arresters, and filled a long-felt want, and I think have some virtues even today, as the manufacturers of the electrolytic arrester use it in a certain form for their switch. It is not perfect, but it requires a minimum of attention; and while all electrical apparatus should have attention, and plenty of it, at the same time a piece of apparatus that will operate with the minimum amount of attention is the most serviceable one to the operating company. The electrolytic arrester is a very interesting piece of apparatus, but it is still in an experimental stage; and as I believe there is going to be a large installation out here, we will watch its behavior with interest. But I do not think we are ready to dispose of the horn arrester until its successor has been more fully tried out

A. G. Jones: I want to differ a little bit with Mr. Lee on the question of the experimental stage. I think the aluminum cell arrester is entirely out of the experimental stage, and has been for the last year or more. I do not mean to say that Mr. Lee has this impression, but a good many people have—they think, when you see the lightning discharge coming, that you have to run and set the aluminum cell arrester to catch it. You do not Some one over in Nevada, I believe it was, said they would not have that kind of arrester around a station, because every time a storm came up you had to watch the arrester, and wait your chance, and catch the discharge when it happened to come in. He got that mistaken impression from the fact that once a week, or every two or three days, the arrester had to be charged; in other words, it had to be periodically looked after. It was a mistaken impression gained from that fact.

J. W. White: I am not acquainted with that person in Nevada, but it is a wonderful country for lightning. At one of our stations we had a multigap lightning arrester. Both Mr. Poole, who was assistant manager, and myself, were afraid to ever connect that lightning arrester in, for the simple reason that I kept a record of one storm at Goldfield, and the lightning went over our horn gaps 24 times in half an hour. Lightning which will discharge over a horn gap set for 40 per cent rise will destroy any multigap arrester in the country. Our line in this particular installation is 3,000 feet elevation at the power station, about 6,000 in Tonopah, 5,000 in Goldfield, and 10,000 going over the White Mountains. One form of lightning is that which is accumulated due to the difference in elevation, and if that condition exists, as it did up there, it would be impossible to use the aluminum arrester with satisfaction, even in the central station, which is the only point where it would be satisfactory in its operation, and it would be necessary to revert back to the horn arrester with resistance and inductive gaps straight to the ground.

A. G. Jones: I don't know. Here is a 12,500, and there are week without any detrimental results, there being, of course, the horn gap in series. This is accomplished by using various kinds of electrolyte. There are two electrolytes. One has a higher resistance, and is the one which is used where it is desired to keep the arrester on the line say seven or eight days without recharging. It is necessary to have just as low a resistance as possible; and where it is easy to look after the arrester every day, the low resistance electrolyte is generally used.

Question: In charging that arrester you connect the top plate directly to the line?

A. G. Jones: No, through a spark gap. You always have a gap there whose length is dependent upon the voltage. In between that gap you put a little wiper, which does not short-circuit the gap, but just shortens it. The charging current of the arrester itself is all the current which passes, and that only for a very few seconds.

Question: Then the leakage, which I understand is about one ampere on the 60,000, is across the air gap?

A. G. Jones: No, I stated 60 *cycles*—not 60,000 volts I don't know just exactly at what voltage that was taken; but of course the leakage current is dependent upon the capacity, the electrostatic capacity, of the arrester; and of course the varying frequency will vary the amount of leakage, or charging, current. There is absolutely no leakage in service, because you have the horn gaps in series at all times. The leakage spoken of in the first part of the paper is in reference to arresters that are on the line continually, that is, we have made a great many tests, by putting 2,300 volt arresters directly on the line, without any gap whatever, and I have left them on at least two or three weeks without any detrimental results.

Question: On a 60,000 volt circuit, how many plates would you use?

Mr. Jones: I don't know. Here is a 12,500, and there are used twenty-six, so you can calculate from that how many there would be on 60,000 volts.

Question: You spoke something about leakage of the current, and you did not state whether it is uniform from a low voltage up to the critical voltage.

A. G. Jones: You take a bare piece of aluminum and put voltage to it, of course the flow of current will depend on the resistance of the electrolyte.

Question: But after the film is formed, after you have your condenser, does the current gradually increase as the voltage increases up to the critical point?

A. G. Jones: The leakage of the current depends upon the breaking down of the film. I explained it as simply "a leaking

safety valve." I stated in the paper there that at 1,200 volts the current was practically a million times what it was at 600.

S. B. Charters: The leakage of the current reduces down to a certain permanent value. Now as you run your voltage up, that increases, but does not increase in proportion to the voltage, but to a slight extent.

Question: The increase is then due solely to the loss?

S. B. Charters: As far as I know.

S. J. Lisberger: Mr. Bowie, when you stated that the time is half an hour that these condensers stay on the line, do you mean subject to intermittent lightning discharges, or that they are capable of withstanding the heat due to the line voltage?

A. G. Jones: I mean that they will continually discharge abnormal voltage for a period of half an hour or more.

S. J. Lisberger: They would not stay on the line indefinitely?

A. G. Jones: No, they would simply overheat, that is all. The electrolyte would probably evaporate to a certain extent.

C. W. Hutton: It occurs to me, from the general drift of the discussion, that the impression is wrong in regard to the function of the cell. Mr. Lee has told us how nicely the horn arrester has assisted them in some of their work. Now we all know that the horn arrester, if we could set the gap close enough to our working voltage, would protect us absolutely; but if we get a slight rise, and the current follows, the general disturbance to the system is such, and would be so frequent, that we could not tolerate it. The function of the aluminum cell arrester is to act like a safety valve in connection with the horn gap. You can therefore set a horn gap, which gap would allow a discharge to pass across it at a slight increase in voltage. The aluminum cell acts as a check valve, so that when the discharge, which is due to the increase, which may be caused either by lightning or a surge, after it has passed through the cell the function of the aluminum is to choke that off, and as soon as the current has stopped within the minimum value (which is done as soon as the reversal takes place) then your arc is extinguished, and your gap is then set in position to take care of another discharge. As far as the heating is concerned, there would be no heating with this unless there is a discharge going through it, and those discharges will be taken care of as they come along; and while the gap is set in proper position the arrester is always in condition to take a discharge. It can stay there for a week, and there would be no current pass through it at all; and the matter of the attention that is required to be given to the arrester in order to keep the film properly formed, simply means that this gap which is in the circuit would perhaps not allow a discharge going across it every 24 hours. If you could bank on that it would never be necessary to charge it; but inasmuch as you don't get that condition, it is necessary to go there, and in some manner to decrease the length of the gap so that a discharge will take place across there and charge the cells.

Question: If you put up a cell like that, and get that film formed on it, it offers resistance to the current in one direction, but not in the other. An alternating current varies. If the cell offers the resistance to one-half the wave, it will offer none to the other half. It is not a question of lightning discharge now at all, but of voltage. Why will one-half the alternating current shunt the flow right through it when the other half is shut off?

H. W. Crozier: As I understand the electrolytic cell they only have one aluminum plate in each electrolytic cell, but in this case they have two plates. In each particular cell they have two plates, and of course they have a number of plates, and each plate performs the object of being a plate with two different cells, that is, one plate is connected to the line, and eventually there is another plate connected to the ground; but the aluminum film acts as an arrester or stoppage to the current in both cases. Now the connection in the electrolytic rectifier of one of the plates is some other material, and one is aluminum. There are two cells in each rectifier. Now I have got started, I want to make a criticism about this matter, and that is, that something is going to happen—supposing, for instance, the lightning is working along in perfect condition, and some accident happened to the installation, or to the oil, or some of our usual transforming troubles, in my opinion the horns are not big enough. Now we have been working a good deal on the line of horns, and horn switching for high voltages, and most people who have had experience in that line have been offering us horns about 6 or 7 or 10 feet long with the expectation of being 100,000 volt circuits. Now the lightning arresters which are to be used on these same circuits have horns only about 3 feet long. I notice in the samples here they are short horns. Now if the horn is to act in the first place just as a gap, to keep the current zero under ordinary conditions, well and good; but in certain emergencies that horn may have to act to stop a dynamic current due to the failure of the arrester, and I believe in that case the horn ought to be very much longer. I believe that is a point which should be considered a little more than it has been.

Now in the design of the station which is to be built here in San Francisco it has only been considered tentatively at present; we are seriously considering setting all these lightning arresters on the roof as the most convenient place and I presume that will make a rather startling appearance to see a whole lot of these lightning arresters on the roof.

C. F. Adams: There is one form of lightning arrester that I haven't heard discussed this evening that I had something to do with some years ago. That was simply a couple of stands of cast iron about 6 or 8 inches square, with a very moderate air gap, and the plate which led to ground was attached to a tumbrel, screened in a wooden box full of water, that wooden box being mounted on insulators. In other words, it was a heavy slab of cast iron with sufficient liquid resistance in series with it to the ground to absolutely limit the flow of current under any condition of discharge. That arrester was put on a 20,000 volt line, and carried the lightning system through some of the severest storms that Nevada could produce. It was brought up to the attention of manufacturing companies, and I learned that it had a fatal defect—it was not a commercial proposition (laughter).

AN UNUSUAL EXAMPLE OF WELDING.

BY O. S. VANCE

Although the use of "thermit" for welding steel and wrought iron is becoming fairly well known, it remained for the engineers of the Los Angeles Gas & Electric Company to press into service this wonderful process for repairing a large casting.

In the electric-generating station of the company a break-down recently occurred in a 12x12 inch vertical Shepherd engine driving a centrifugal pump for the condenser of one of the large turbine units. While the accident caused no interruption in service, it put the condenser out of commission and rendered the operation of the turbine unit impracticable until the broken part could be repaired or a new one substituted. The break existed in one of the two cast-iron members which constituted the main frame of the engine, parting at a point close to the cylinder where a crack had been noticed for some time previous. As the broken member was quite complicated in form it could not be used as a pattern in casting another; while to make a pattern and cast, machine and fit a new part, or to wait until a duplicate casting could be obtained from the engine builders, would mean considerable delay and expense. The superintendent of the station, who had had some experience with the use of thermit in welding steel and wrought iron, believed that if properly handled the broken casting could be saved by the use of the agent, and with the assistance of a couple of railroad mechanics who were familiar with the thermit process in welding steel locomotive frames, but were reluctant to attempt it with cast iron, undertook the job.

To repair the engine frame in question required but twenty-two hours, including the time necessary to collect the various materials, the preparation (including the drying out and thorough heating) of the molds, and running in the thermit; and the entire cost was but nominal.

A NEW MANAGER.

The Western Electric Company announces the appointment of Mr. T. E. Burger to the position of manager of their Los Angeles house, the California Electric Company, succeeding Mr. Richard Spencer, who severed his connection with that company some months ago.

Mr. Spencer took up electrical work on the Pacific Coast

RICHARD SPENCER
Former Manager California Electric Company

in 1903 at Seattle at which point he had charge of the Northwest business of the John R. Cole Company of San Francisco. On the opening of an office in Los Angeles by that company in 1904 he was transferred to that point and continued in charge for three or four months, after which he accepted the management of the Los Angeles office of the Western Electric Company.

T. E. BURGER
Manager California Electric Company

In October, 1905, the Western Electric Company purchased the supply business of the Machinery & Electrical Company at Los Angeles and entered the supply field under the name of the California Electric Company with Mr. Spencer as manager. In March, 1908, Mr. Spencer was compelled by ill health to discontinue work and since then has been located at Dansville, New York, where his many friends will be glad to know that he is on the road to full recovery.

Mr. Burger joined the force of the Western Electric Company at Los Angeles in 1906 as salesman and through unusual executive ability and natural adaptability to sales work was advanced to the position of assistant manager, a position he held at the time of Mr. Spencer's retirement. His recent advancement is a well earned recognition of conscientious and faithful work.

GENERAL ELECTRIC TEAM WINS AT BASEBALL.

On Saturday, April 24th, a picked team of ball players from the General Electric Company, under the management of Frank D. Fagan, defeated the "All San Francisco" nine made up of players from the other electrical houses, managed by Milo E. Hicks.

The line-up of the teams and the score was as follows:

GENERAL ELECTRIC COMPANY.

	1	2	3	4	5	6	7	8	9
Spaulding, 1b	1	1	0	0	0	0	0	1	0
Wheeler, l.f.	1	1	0	0	0	0	0	0	0
Lottridge, c.	1	0	0	0	0	0	0	0	0
Carden, s.s.	0	0	0	0	0	0	0	0	0
Crosthwaite, p	1	0	0	0	0	0	1	0	0
Hunt, 3b	0	0	0	0	0	0	0	0	0
Jones, c.f.	0	0	0	0	0	0	0	0	0
Langor, 2b	0	0	0	0	0	0	0	0	0
Winchell, r.f.	0	0	0	0	0	0	0	0	0

"ALL SAN FRANCISCO."

	1	2	3	4	5	6	7	8	9
Kahn, 3b	0	0	0	0	0	0	0	0	1
Jones, s.s.	0	0	0	0	0	0	0	0	0
Drendell, r.f.	0	0	0	0	0	1	0	0	1
Ehrenfort, l.f.	0	1	0	0	0	0	0	0	0
Prince, 1b	0	0	0	0	0	0	0	0	0
Loughborough, 2b	0	0	0	0	0	0	0	0	0
Branch, c.f.	0	0	0	0	0	0	0	0	0
Marcus, c.	0	0	0	0	0	0	1	0	0
Hickox, p.	0	0	0	0	0	0	1	0	1

SCORE BY INNINGS:

	1	2	3	4	5	6	7	8	9
General Electric Company	4	2	0	0	0	0	1	1	0—8
All San Francisco	0	1	0	0	0	1	2	0	3—7

A return match has been arranged for at an early date, when the "All San Francisco" team hope to obtain their revenge.

GOVERNMENT TELEPHONY.

The Saskatchewan Government has finally purchased the system of the Bell Telephone Company in that province. The price paid was $367,000 in cash and there is yet due the province some $10,000 in unearned rentals. The system consists of 469.4 miles of long-distance lines with 13 exchanges. The transfer will be made at midnight, April 30-May 1. This was the last mileage the Bell Company owned in Canada between the Great Lakes and the Pacific Coast, and press dispatches state the Ontario Government will shortly consider the purchase of the company's system in that province.

A COMPTROLLER FOR THE PACIFIC LIGHT & POWER CO.

A. W. Kemp, recently cashier with N. W. Halsey & Company, bankers, of San Francisco, has been selected as the comptroller for the entire system of the Pacific Light & Power Company, with headquarters at Los Angeles.

This change on the part of the Pacific Light & Power Company, in connection with their recent sale of $1,000,000 worth of bonds, is of considerable significance and an indication of some important developments in the near future.

Train dispatching by telephone is being substituted for the telegraph on the main lines of the Illinois Central Railroad.

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CONTENTS

The Telephone Receiver

The evolution and expansion of the modern telephone system is undoubtedly one of the marvels of recent times. A generation ago little credence would have been given to a prophecy that within a few years any mechanical means of voice transmission could have become so intimately associated or intertwined with business and social relations that its suspension, even for a short time, might result in widespread hardship as well as pecuniary loss, yet, not the least exaggeration attaches to such a view, as evidenced by the recent Paris strike of telephone and telegraph employes.

The fact is the public is becoming more and more dependent on time saving appliances, and among these the telephone is pre-eminently representative. Few people, not barring the electrical fraternity, ever think of the telephone other than from an economic or commercial standpoint. Nevertheless, mechanically, the subject is one of fascination.

The soul of the system naturally lies in the receiver, without which no practical results would be possible. This instrument is simplicity itself. Composed, as it is, of only three essential elements—a permanent magnet, a coil of fine wire and a thin iron diaphragm, the little device has resisted displacement or substitution in face of the combined scientific and inventive forces of the world. Its sensitiveness is almost beyond conception, an ordinary receiver, according to Preece, being affected by a current as infinitesimal as six hundred quadrillionths (000,000,000,000,600) of one ampere. To put it graphically, a string of hand phones reaching, end to end, six thousand times around the earth, or over one and a half times the distance from the earth to the sun would respond to the amount of current required by an incandescent lamp of 32 candle-power. The astonishment created by these figures may even be increased when it is considered that recent wireless telephone receivers are even more sensitive.

When talked into, directly, the receiver absorbing energy from the voice becomes in effect a diminutive, though actual dynamo; and with its diaphragm vibrating in front of the permanent magnet surrounded by coiled wire, induces in this wire its tiny electrical load, of which the line wire forms a part of the circuit.

Originally, the telephone receiver, owing to its reversible qualities, was used both for transmitting and receiving, but the demand for increased loudness and more distant transmission long ago relegated it to duty in the latter role, although its usefulness is not confined to voice reproduction alone. Many instruments for delicate electrical measurements have recourse to the sensitiveness of the receiver and a large field for it has recently been opened in wireless telegraphy.

It is remarkable, that while great strides have been made in other departments of telephony, notably in transmission, line construction and switchboard operation, the unpretentious bit of apparatus in question has suffered no fundamental change since its first appearance.

CURRENT COMMENT

A tax on poles, other than trolley, is being considered by the Board of Supervisors of San Francisco.

Telephone lines in Saskatchewan were taken over by the government on May 1, as all long-distance lines, local exchanges and equipment have been purchased from the Bell Telephone Company.

Japanese government telephone exchanges are 206 in number of which 122 were installed in 1908, including Formosa, Korea and Manchuria. Any place is provided with a telephone upon application.

A telegraphic block system for the operation of all railway trains will be compulsory if a bill introduced in Congress by Representative Hardwick be passed.

The Corporation Commission of Oklahoma has ordered the Atchison, Topeka & Santa Fe Railway to have a telephone at its railway station in Skedee on the ground that the telephone is a necessary convenience.

The Cleveland Industrial Exposition will be held June 7 to 19, 1909, under the auspices of the Chamber of Commerce of Cleveland, Ohio. Many representative electrical manufacturing firms are among the exhibitors.

"Pupin" is the suggested unit to replace "miles of standard cable" which causes considerable confusion for those dealing with telephone transmission phenomena. The Post Office Electrical Engineers' Journal of London is responsible for the suggestion.

Telephones in National Forests are one of the chief factors in minimizing fires. $600,000 is spent annually in building roads, trails and telephone lines to facilitate communication. In many districts telephone lines have been built between the supervisors' office and ranger headquarters and to prominent peaks which are used as lookout stations to observe fires.

Fuel oil has increased the steaming radius of a war vessel 4000 miles and eliminates the chances of detection because of more perfect combustion. Oil is 60 per cent cheaper than equivalent coal on the Pacific Coast and is taken on board much more easily. Such is the result of a six months' trial on the monitor Cheyenne which has recently returned to the Mare Island Navy Yard. This trial forms the basis of a recommendation to the Navy Department that oil burners be installed on all war vessels.

The Teishinsho wireless telegraph in Japan, which differs from the Marconi and De Forrest systems, is used on nearly all Japanese steamships on foreign lines. In the navy all ships, from battleships down to torpedo-boat destroyers, are equipped with wireless telegraphy, and the wireless telephone was successfuly used at the grand naval review off Kobe last autumn. The wireless telephone is being studied in the communication department and in the navy. Wireless seashore offices are at Chasi, Kadoshima, Ochiishi, Osozski and Ushiozski.

PERSONALS.

J. T. Carper, president of the Denver and Colorado Securities Company, and J. J. Abbott of Denver are visiting some of the California power plants.

G. E. Pingree of the New York office of the Western Electric Company, reached San Francisco on May 3d on a return trip from China where he has spent about six months on special work of interest to his company.

T. E. Bibbins, assistant manager on the Pacific Coast of the General Electric Company left on May 4th for the East where he will attend the annual conference of managers of his company at Schenectady, N. Y.

James A. Anderson, who has been connected for some time with the Electric Railway and Manufacturers' Supply Company of San Francisco, left for Chicago on April 30th, where he has accepted a position with the American Safety Paper Company.

F. L. Pierce, treasurer of the Cutler Hammer Manufacing Company, Milwaukee, Wis., spent several days of last week in San Francisco after a brief vacation in Southern California. He will continue his coast trip through the Northwest, returning East from Seattle and Spokane.

W. B. Potter, engineer of the railway department of the General Electric Company, is now fully recovered from his recent illness and operation, due to unusual effort and fatigue incurred during his long trip over the Pacific Slope, investigating power and traction conditions there. Mr. Potter has been under private treatment in New York City, but is now convalescent and resuming work, much to the pleasure of a host of friends.

TRADE CATALOGUES.

The Western Electric Company illustrate and describe Telephone Aims for office service in a neat folder.

Bulletin No. 112, issued by the Crocker-Wheeler Company, Ampere, N. J., on Exhaust Fans shows the variety of service to which these fans have been adapted.

The monthly Bulletin from the Ohio Brass Company of Mansfield, Ohio, contains a brief description of the Oregon Electric Railway System, in addition to the usual news and anecdotes.

Jandus Fans are handsomely portrayed in Bulletin No. 35 from the Standard Electrical Works, San Francisco, Cal. These fans are made for both direct and alternating current for all kinds of service.

Salesman's Information comprises an interesting series of questions and answers regarding the Couch & Seeley Co. "Ideal" Automatic Button Switch Inter-communicating Telephone, for which the Standard Electrical Works are San Francisco agents.

Widely differing machines are driven by large direct current Crocker-Wheeler motors as described in Bulletin 113 issued by the Crocker-Wheeler Company, Ampere N. J. These motors are used on lathes, hoists, bloom shears, big rolls, and ammonia compressors. Important features of construction are clearly explained and are illustrated with photographs that will give details of construction, and others showing the motors installed for service.

Booklet No. 3770, issued by the General Electric Company, describes a Telephone Line Insulating Transformer. The purpose of this apparatus is to safeguard the users of telephones from the dangers of high voltage due either to induction or accidental contact between telephone and power lines and to improve the telephone service by removing the ordinary small ground gap carbon arrester from direct connection with the line, as well as providing ample insulation between the interior wiring, instrument, batteries, etc., and the line.

THE JOBBERS PLAY GOLF AT DEL MONTE.

T. E. BIBBINS
Winner of the Del Monte Cup, P. J. Aaron of Seattle in the background

THE SECOND Golf Tournament of the Electrical Jobbers' Association of the Pacific Coast was held at Del Monte, California, on April 24th and 25th and the much-coveted Del Monte cup was won by T. E. Bibbins of the General Electric Company, San Francisco. The former winner, W. L. Goodwin of San Francisco, made a gallant struggle to retain it, but was nosed out by a paltry 18 strokes—only one stroke a hole—which indicates how close a match it was.

The weather was all that could be desired and the course was in perfect condition. Play started at 10 o'clock on the morning of the 24th, 16 members taking part, the handicaps being based on the results of the match of January 17th, 1909. Following is the score:

	Actual Strokes.	Handicap	Net.
Bibbins, T. E.	122	60	62
Goodwin, W. L.	112	32	80
Knoche, G. A.	150	67	83
Woodward, F. H.	146	59	87
Davis, R. J.	97	6	91
Holabird, R. D.	101	9	92
Scribner, E. M.	114	22	92
Hillis, C. C.	162	59	103
Brown, W. S.	163	60	103
Elliott, A. H.	149	44	105
Berry, W. S.	131	20	111
Carrigan, Andrew	125	6	119
Carter, H. V.	182	60	122
Burger, T. E.	152	30	122
Kuhn, Robert	159	30	129
Gilson, C. L.	190	53	137

The conclusion of the principal match found 15 of the participants with an ambition still ungratified and it was decided to give them another opportunity. A second match was arranged for the morning of the 25th, the 16 players being divided into two divisions, the first and second eight, and each eight played an eighteen hole match for a box of golf balls.

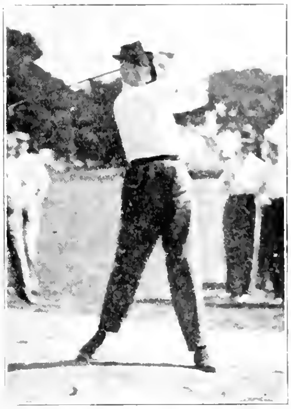
The prize in the first eight was won by F. H. Woodward, and in the second eight by G. A. Knoche. Mr. Bibbins, who won the cup on the previous day, played this match out, but generously refrained from winning, his courtesy being greatly appreciated by the others.

On the night of the 24th an elaborate dinner was tendered to the winner at the Hotel Del Monte, at which 30 members and guests were seated. The number included Robert Kuhn of the American Electrical Heating Company, Detroit; H. B. Vanzvoll, secretary of the Sunbeam Incandescent Lamp Company, Chicago; Wm. Coale of the Sterling Electric Manufacturing Company, Warren, O., and E. M. Latham, purchasing agent of the Pacific Light & Power Company, Los Angeles.

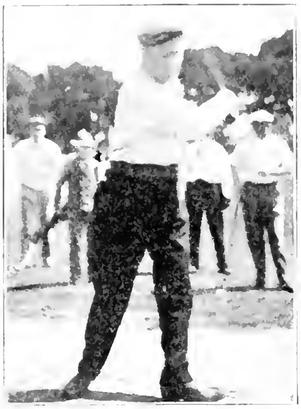
At the conclusion of the dinner the trophy was filled and started on its rounds, each man, as he quaffed, responding to the toast to the winner and wishing better luck at the next meeting to the losers.

The dinner was ably managed by Andrew Carrigan as toastmaster, assisted by R. D. Holabird.

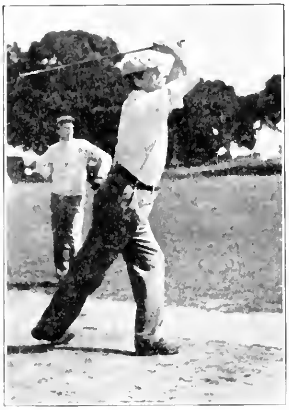
Incidental to the golf tournament several business meetings were held, conveniently arranged at such times that they would not conflict with the game. They were of a purely routine nature and the only business of importance transacted was the appointment of a permanent golf committee, consisting of Andrew Carrigan, R. D. Holabird, W. L. Goodwin and E. M. Scribner.



W. S. BERRY
The beginning of a left hand drive



W. L. GOODWIN
The "loser" of the cup



ANDREW CARRIGAN
Finishing a remarkable iron shot

It is interesting to compare the scores made at the match of January 17th with those of April 24th, and the following figures will give some idea of the uncertainty of the game:

	Actual Strokes.		Net.	
	Jan. 17.	Apr. 24.	Jan 17.	Apr. 24
Bibbins, T. E.	160	122	133	62
Goodwin, W. L.	132	112	87	80
Knoche, G. A.	167	150	113	83
Woodward, F. H.	159	146	105	87
Davis, R. J.	106	97	110	91
Holabird, R. D.	109	101	105	92
Scribner, E. M.	122	114	112	92
Hillis, C. C.	159	162	105	103
Brown, W. S.	....	163	...	103
Elliott, A. H.	144	149	90	105
Berry, W. S.	120	131	105	111
Carrigan, Andrew	106	125	110	119
Carter, H. V	....	182	...	122
Burger, T. E.	..	152	..	122
Kuhn, Robert	.	159	.	129
Gilson, C. L.	153	190	99	137

The bogie on the course is 73.

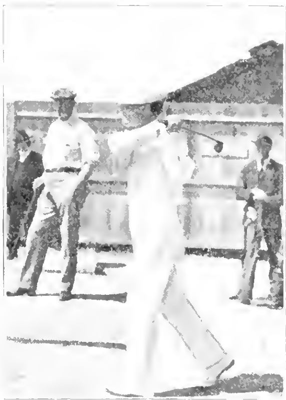
The next tournament will be held at Seattle in June.

An exciting 9 hole foursome was played on the afternoon of April 25th, between R. J. Davis, Andrew Carrigan, R. D. Holabird and E. M. Scribner for a ball a corner, Mr. Carrigan winning the match by one stroke over Mr. Scribner.

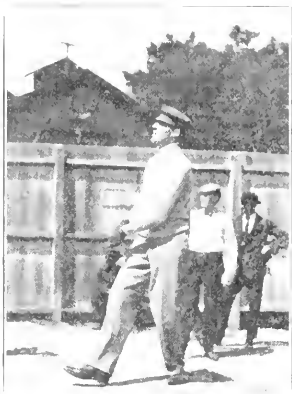
When A. H. Elliott and C. C. Hillis were about to drive off the seventh tee, Fobes of Seattle bet Fowden of San Francisco 8 bits that Elliott would drive into the woods on the left and Hillis would drive into the woods on the right. Fobes won.

G. A. Knoche threw his club on the first drive, the club landing ten yards beyond the ball and he claimed the right to play the ball from the point where the club lay. It was necessary to call in the Golf Committee to decide the point, which was against Knoche.

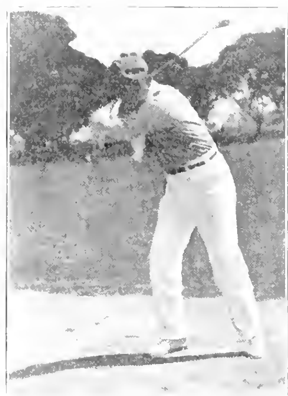
W. S. Brown was the only member of the Seattle delegation who entered the tournament but through lack of sleep was unable to keep more than one eye on the ball at a time. With a little more practice and a great deal more sleep Mr. Brown should have no difficulty in landing in the first division.



R. D. HOLABIRD
The cup winner, Mr. Bibbins is on the left



G. A. KNOCHE
Remarkable position at the finish of a "clubless" drive



E. M. SCRIBNER
An example of perfect golf form

NOTES OF THE GOLF GAME.

Andrew Carrigan was unfortunate in his drive from the second tee, the ball landing in the high grass, costing him 18 strokes.

R. D. Holabird was the symbol of purity, being dressed entirely in white, and played with a white ball. He was the most handsomely gowned man on the course.

Mrs. Andrew Carrigan, Mrs. W. S. Berry and Mrs. Wm. Coale of Warren, O., were interested members of the "gallery" and offered first aid to the injured on several occasions.

G. A. Knoche was as unfortunate at pool as he was at golf. In a game with R. D. Holabird he succeeded in pocketing only two balls and was compelled to spot half of them as a result of an unfortunate scratch.

NOTABLE SWITCHBOARD ORDER.

The new "Wade" exchange for the Cuyahoga Telephone Company at Cleveland, Ohio, has just been ordered of the Dean Electric Company. This is the largest single contract placed by an independent operator since the Detroit Home Telephone Company ordered their mammoth equipment of the same manufacturer.

The exchange consists of ten common battery multiple sections with four additional sections comprising a "B" board. A capacity of 3240 lines is to be installed for immediate service with an ultimate capacity and present equipment of 6,400 lines.

The order includes complete power and terminal facilities, as well as the necessary apparatus for Dean Harmonic selective party line service. The new exchange will relieve the over-load on the "Central" and "Crest" exchanges of the Cuyahoga Telephone Company.

INDUSTRIAL

INTERCOMMUNICATING TELEPHONES.

The increasing demand for intercommunicating telephone service throughout the country has induced the Western Electric Company, the largest manufacturers of telephones in the world, supplying all the equipment used by the entire Bell system, to place on the market, two types of metal automatic intercommunicating telephone equipment. These sets

Fig. 1

are made in two types, a non-flush set for mounting on a wall, and a flush set for mounting in a wall. All apparatus is compactly mounted in a fire-proof iron case, having a hard, durable, black japanned finish with nickel trimmings. Owing to the attractive appearance of this set, it is in keeping with the furnishings of any room.

Fig. 2.

The non-flush wall set has all the telephone apparatus mounted on a door, which is hinged at the bottom so it can be swung down as in Figure 2. To make the apparatus accessible for maintenance and inspection, all current carrying parts, including the transmitter, are insulated from the case, and a concealed binding post receiver is used. A special feature of this set is the dust-proof side used in connection with the switch hook to prevent dust from entering the case through the switch hook slot.

The flush wall set, Figures 3 and 4, possesses all the features of the non-flush type, and in addition, the front of the set is removable from the back, this permitting the back of the set to be used as an outlet box. This set may be placed

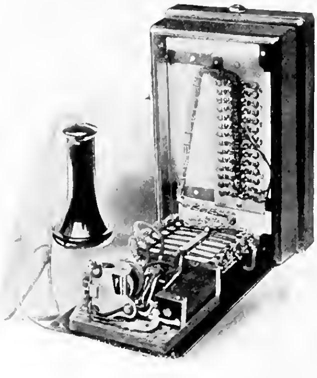


Fig. 3.

in a residence or building while the building is under construction, or in an old building before the wiring is started, and the front of the set containing all the working parts, fastened in place when convenient. The advantages of this feature will appeal to contractors, and those installing sets in old or new buildings.

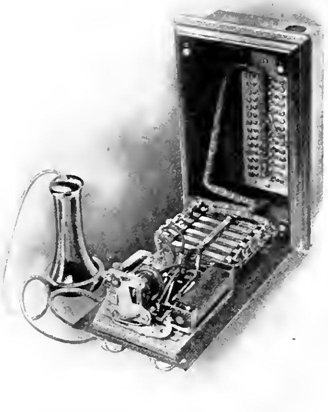


Fig. 4.

The superintendent's call equipment can be furnished for any of the stations, to enable a general call being given throughout the system for the superintendent, who may be in one or another of the departments.

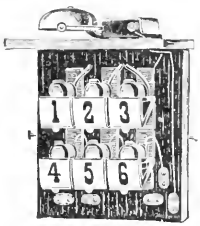
Either full metallic or common return wiring may be used to connect the stations together. The former ren-

ders the system less subject to inductive disturbances and cross talk, and this is to be recommended especially if the system is to be connected to an exchange or outside service. If the maximum distance between any two stations is 500 feet or less, the ringing battery should have a potential of about 4 volts, and the talking battery about 4 volts. With 1200 feet as a maximum distance, potential of the ringing battery should be 5 volts, and of the talking battery 4 volts. With 2,000 feet as the maximum distance the ringing battery should have a potential of 7 volts, and the talking battery of 6 volts.

These sets have a capacity of 12 stations, each set being provided with 12 buttons, one button for each station, and the name plate is provided with space opposite each button for designating the name or location of the station associated with the button. The same button is used both for signalling the station desired, and for establishing telephone connection.

EDWARDS' ANNUNCIATORS.

A new style of annunciator has been placed on the market by Edwards & Co. of New York City through the Western Electric Company as distributing agents. The annunciator is of the lock gravity drop type and is especially designed for ease of installation at minimum cost. The back



Edwards' Annunciator, Showing Mechanism.

board containing all the drops, connectors and bell is first fastened to the wall and the connections and tests made. The covering case is then easily and quickly fitted by means of brass hooks, requiring no screws or tools. In the same way it can be taken off at once without tools should it be necessary to inspect or change the tags.

The connectors are at the bottom of the back-board where most accessible and require no solder. The case is of selected oak, neatly designed and finished. It completely

Edwards' Annunciator, Complete.

covers the Eco bell which is mounted on top of the backboard, thus eliminating clogging by dust. The restorer is conveniently placed at the bottom and the gravity drops give large, clear indications that can be cheaply replaced. The whole device is claimed the best and at the same time one of the lowest priced on the market.

MULTILETS.

An improved stamped steel knockout box has been placed on the market by the well known conduit manufacturer, the Sprague Electric Company. This box is called Multilet because that name practically tells the whole story—one box with many uses. It is made in two sizes with a set of covers

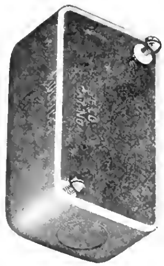


Fig. 1.

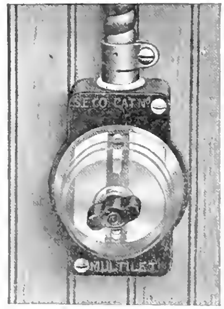


Fig. 2.

for each size. This combination apparently meets all requirements and greatly simplifies the stock problem for the jobber and contractor, and also for the wireman whose work need not be delayed while he is hunting for some particular fitting. With the Multilets, no special fittings are required for special work, and, hence, there need be no expensive

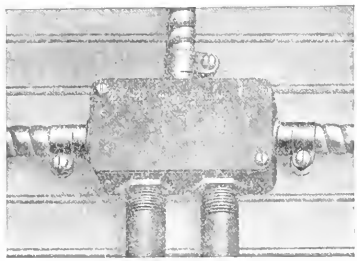


Fig. 3.

delays. The Multilets also ensure a uniform and safe installation.

The Multilet box, shown in Figure 1, has six oulets, one in each end, one in the bottom, two in one side and one in the other. The box and covers, except those that are porcelain, may be obtained in either galvanized or enameled

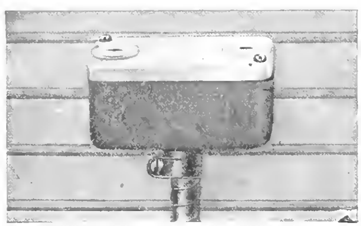


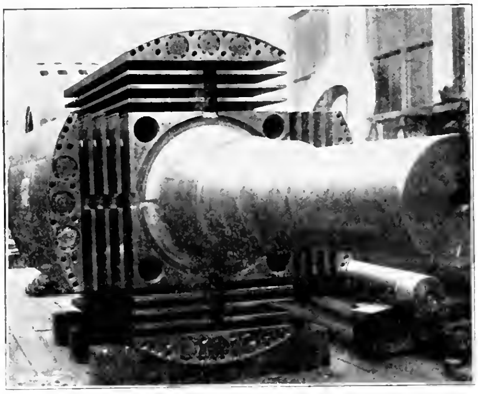
Fig. 4.

finish. The box occupies little space yet affords plenty of room inside for the wires. It accommodates standard fittings, such as rosettes, receptacles, snap switches, etc.

Several types of covers are shown in Figures 2, 3 and 4, and a full line of them will be found in Catalogue No. 424 a copy of which may be obtained by addressing the company at San Francisco or Seattle.

WESTINGHOUSE GENERATOR FOR CITY ELECTRIC COMPANY.

The accompanying illustration shows the rotating field of the 15,000 k. w. turbo-generating set that is being installed by the Westinghouse Electric & Manufacturing Company in the North Beach plant of the City Electric Company of San Francisco. The photograph was taken in the shops before shipment. The length of the rotating field at its shaft is 17 feet 10 inches and the weight 60,000 pounds.



Rotating Field of 15,000 h. p. Turbine Generator Set for City Electric Company.

VULCAN ELECTROCURL.

The Vulcan Electric Heating Company of Chicago, who have for some time past manufactured electric curling irons, marketed by the Del Sales Company of Chicago, announce the discontinuance of their selling arrangement with that company and their policy to handle their product with the trade direct in future.

This device will be marketed by them under the name of the Vulcan Electrocurl No. 5100, the list price established being $3 each.

Vulcan Electrocurl

The manufacturers' claims for the Electrocurl are that it is elegantly finished, strongly made, has a dependable heating element, convenient cord connector and an improved durable cord fastening. It is thoroughly reliable and practical and makes a handsome present. At 10 cents per k. w. it costs but 1-3 cent per hour to operate. It maintains a constant heat generated from within and in its cleanliness, convenience and safety is superior to any other means for the purpose. It is a luxury which will undoubtedly become a necessity in the near future.

IMPORTANT DEVELOPMENTS IN BITUMINOUS GAS PRODUCERS.

For a number of years the Westinghouse Machine Company has been engaged in the development of a satisfactory form of producer suitable for gasifying the usual grades of bituminous fuels. The unusual difficulties encountered in the utilization of this kind of fuel have resulted in the trying out of many diferent types, both of the producer itself and of the necessary auxiliaries for producing clean gas. For the past year and a half, however, the company has been engaged in carrying out upon a commercial scale, a producer plant which is now upon the market. These tests have not been conducted with a toy apparatus, but with a full-sized equipment of 175 horsepower, including a standard gas engine of about the same power, by means of which the actual power value of the gas produced and the overall efficiency obtainable, were determined without possibility of error.

The above-mentioned tests were brought to a conclusion on April 3d, by drawing the fire in the producer after it had been in continuous operation on various loads and on various fuels for a year past, these twelve months having been devoted to tests of one to four weeks' duration, both ten and twenty-four hours per day on standard fuels available for power purposes. These fuels included Pittsburg slack and run-of-mine, lignites from northern Colorado, Texas and South America, also peat and other fuels from various parts of the country. Most of the tests the load on the equipment was maintained at full rating, although one special test of one month and a half duration was made to determine accurately the standby loss of the producer standing idle.

The drawing of this fire after one year's operation was made the occasion of a demonstration of the producer plant before government officials and engineers from various parts of the country especially interested in bituminous gas practice.

The fire was drawn without trouble or interruption as large clinker formations were entirely absent, although the producer had, just previous to this occasion, been running on a full-load test for one month, using Pittsburg coal. The lining of the producer was found to be practically intact and in quite good enough condition for continued operation for an unlimited period.

A detailed examination of the piping leading from the producer house to the engine on test, showed that during this long period of operation, there had been no deposits of tar or lampblack. As a matter of fact, this piping had not been examined for about two years and a half of producer experimentation.

The most important feature of the demonstration was the entire absence of tar formed in the producer gas. A similar examination of the mixing and inlet valves of the engine which has been used for the past year on this test, showed practically no deposits of tar or lampblack, such as would interfere with the operation of the engine. The Westinghouse plant uses no tar extractors, as no tar is made, simply a static washer of small size in the place of the usual bulky coke scrubber. A rotary exhauster draws the gas from the fuel bed and delivers it to the engine at a definite pressure.

No gas holder is used in this process, as the producer regulation is entirely automatic. The gas produced has a moderate heat value suitable for high compressions in the gas engine, and is uniform and clean, average samples showing not more than .02 to .03 grains per cubic foot impurities.

The ash is fairly clean, and analysis of samples from time to time shows that not more than 1% to 3% of the combustible in the coal escapes in the ash.

The various fuels which have been used in this producer on test, have been gasified successfully, and have run as high as 34% moisture, 35% volatile and 15% ash and 1½% sulphur. The results of the tests show that with coal, such as Pittsburg slack or run-of-mine, an overall economy of 1.1 pounds per brake horsepower hour can be secured, equivalent to a little over 9/10 pounds per indicated horsepower hour. Moreover, the producer efficiency does not vary more than 10% from full load on the plant to no load.

The results of this past year's tests have fully convinced the builders that the apparatus experimented with possesses unusual commercial value, and preparations are being made for extensive manufacture. A plant of this type has been in operation for over six months on Colorado lignite coal with equal success, as evidenced by an order recently placed with the Westinghouse Machine Company for duplicate shipment.

DEAN TOLL SWITCHBOARD.

The Lincoln Telephone Company of Lincoln, Nebraska, has just ordered a six section toll switchboard from the Dean Electric Company. The contract includes complete terminal, power and telegraphing facilities. The development of telegraph service in connection with long distance telephone work, has been given special attention by Dean engineers. The contract includes a two position Chief Operator's desk, a two position Wire Chief's test board, main and intermediate distributing frames, battery racks, repeating tables, and power plant complete. The exchange is equipped for sixty lines, with an ultimate capacity of well over that number. Service is provided by lamp signal bridged multiple equipment. By this method all series contacts in the talking circuit are eliminated. Service is handled through a complete and solid metallic circuit free from any complications whatsoever.

NEWS OF THE STATIONARY ENGINEERS.

Cal. No. 3, National Ass'n of Stationary Engineers, held a regular session on Wednesday evening, April 28, and an unusually interesting meeting took place, many questions of interest to the practical engineer being discussed. Mr. H. D. Saville, president of the State Association, reported having visited, in company with Mr. Chas. L. Turner, San Jose Association No. 6, on Wednesday, April 21, and expressed himself as being much gratified at the progress in association affairs in San Jose. The members there announced that the San Jose contingent of members and families, together with a number of the San Jose men of affairs purposed chartering a special train to convey them in a body to the State Convention which takes place in San Francisco in June. The State President also stated that before the convention took place he hoped to announce the formation of new associations in Sacramento and Santa Cruz.

Los Angeles No. 2 held an election on April 30th for delegates to the convention to be held in San Francisco, June 14-19, and eighteen were elected, with the same number of alternates, who, as their wives will accompany them, will make a pretty respectable showing from the South.

Los Angeles members are looking forward with much interest to a promised lecture by Bro. T. S. Thomson, Chief Engineer of the Los Angeles Gas & Electric Company's electric station, on the subject of "Steam Turbine Practice," which will be much appreciated by the members. It has been promised for May 21st.

National President Fischer and State Secretary Curl have been invited to go to Santa Barbara and pay No. 5 a visit and meet the leading business men of that city, around the festal board, and May 8th has been decided on for the trip. A very enjoyable time is expected, as the members of No. 5 are "on the job" when it comes to entertaining, to which all those who attended the State Convention there in 1905 can testify.

ENGINEER MISSING.

Chas. L. Brandon, a member of Cal. Ass'n. No. 3, N. A. S. E., has been missing since last September and his friends and relatives are greatly concerned regarding his mysterious absence. Mr Brandon was last heard of in Spokane, where he was on the lookout for a position, having just left the position of master mechanic at the British Columbia Copper Company, Greenwood, B. C. Mr. Brandon was about 30 years of age, 5 feet 10½ inches in height, and weighed when well, about 160 pounds; had dark hair, eyes and complexion. Was smooth shaven when last seen. Any information concerning Mr. Brandon will be gratefully received and forwarded to his wife by David Thomas, Secretary California No. 3, N. A. S. E., 914 O'Farrell Street, San Francisco, Cal.

TRADE NOTES.

The Parker-Clark Electric Company, with which Company Mr. Walter G. Clark, formerly with the Kilbourne-Clark Company, Seattle, is associated, announce their removal on May 1st to their new offices in the Singer Building Tower, 149 Broadway, New York.

The Pelton Water Wheel Company supplied the four 5000-horsepower Francis turbines used in the Schaghticoke hydro-electric station which generates electrical energy for the General Electric Schnectady works. The Pelton Company also supplied the speed governors.

The Willapa Harbor Telephone Company of South Bend, Washington, has contracted with the Kellogg Switchboard & Supply Company for complete common battery office equipment and telephones for South Bend, and for complete telephone equipment for Raymond, Washington, to operate in connection with its present switchboard.

The new White House of San Francisco was opened for business Saturday evening, March 13th. It is lighted by multiple glower Westinghouse Nernst lamps in ornamental fixtures. The total installation consists of 1,000 glower units. This is one of the finest stores in the rebuilt down-town district. The opening was attended by no less than 75,000 people.

Dossert & Co., of New York, report the receipt of the following large orders during the current week: 2,500 flat shank solderless lugs and 1,500 3-way connectors from the Edison Electric Illuminating Company of Brooklyn; 300 3-way connectors for shipment to South Africa; 100 cable taps and 3-way from the Mengel Box Company of Louisville, Ky., a large number of insulated 2-way joints from the Wagner Electric Manufacturing Company, of St. Louis, Mo., and a number of special terminals for use in the equipment of electric furnaces in the Niagara Falls plant of the American Cyanide Company.

The Westinghouse Electric & Manufacturing Company, Pittsburg, Pa., announces that it has received a contract from the Falkenau Electrical Construction Company of Chicago, engineers for the Salt Lake & Ogden Railway Company, covering direct suspension line material for the thirty-seven miles of electrification of the present steam road between Salt Lake City and Ogden.

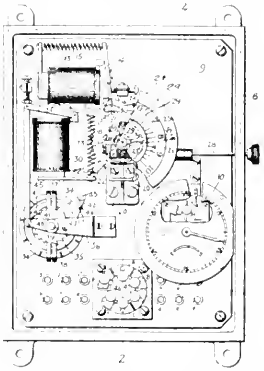
In the same connection, a contract has been closed covering the line material for the Gallatin Valley Electrical Railway Company, of Bozeman, Mont., for eighteen miles of new line; and an order has also been entered from the Long Island Railroad, covering twelve miles of low-voltage catenary construction.

The Kellogg Switchboard and Supply Company of Chicago have just closed a contract, through their San Francisco branch, with the Prescott Electric Company of Prescott, Ariz., for equipping their exchange with a new two-section multiple harmonic switchboard. This board will have 520 lines equipped and will be complete with power plant and distributing frame. The Kellogg 4-party harmonic telephone will be used.

The Kellogg Switchboard and Supply Company have also closed a contract with the Montana Star Telephone Company, Culbertson, Montana, for a 200-line express type switchboard with 100 lines equipped, which apparatus is now being installed.

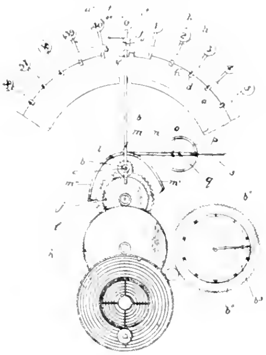
PATENTS

918,848. **Signal System.** John L. Hall, Schenectady, N. Y., assignor to General Electric Company. In a signal system, the combination of a transmitter, a receiver arranged to respond thereto, a time mechanism in the transmitter, a movable contact operated thereby, a spring to retract the



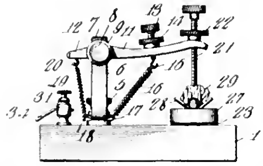
movable contact when released, a contact adapted to be engaged by the movable contact, means for adjusting the same, and means controlled by said contacts for releasing said movable contact and for causing the receiver to give its indications.

918,955. **Telephone System.** Charles F. Bradburn, Delmer, Ontario, Canada. In a telephone system, a selecting apparatus consisting of a primary dial having a series of contact plates arranged in an annular formation one of which is employed as the initial contact plate, a primary pointer revolvable on the primary dial and arranged to successively



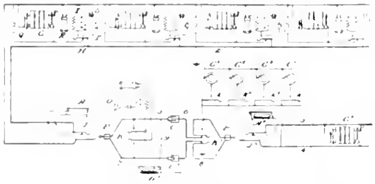
engage the contact plates, a detent stop to hold the primary pointer at its initial position and normally set in the path of the primary pointer, an arresting stop for each of the other contact plates normally clear of the path of the primary pointer and adapted to be set in the path of the latter, and an actuating spring to return the detent stop to hold it in its operative position.

918,618. **Wireless Telegraph Receiver.** Wesley M. Way, Austin, Tex., assignor to George W. Trommlitz, Galveston, Tex. An electric wave detector comprising a cup or holder for a suitable crystalline mass, said cup being rotatable, a carriage movable about an axis parallel to the axis of rotation of the cup or holder, an arm pivotally connected to the carriage and movable about an axis at right angles to the axis of



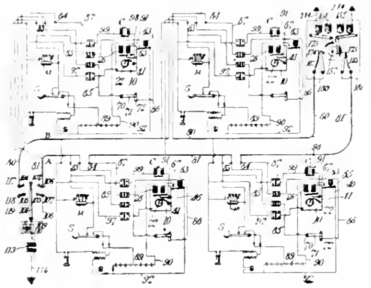
rotation of the carriage an adjustable contact screw carried by the arm in position to engage a crystalline mass carried by the holder, and opposing springs connected to the carriage and to the arm on opposite sides of the pivot of the latter.

918,852. **Telephony.** Ruben C. M. Hastings and Thurston Matheny, Athens, Ohio. In telephony, a party line system including an all metal circuit to which the local talking circuits are bridged, selecting means arranged at the local stations and connected in series in the limbs of the circuit,



means for grounding the opposite ends of the limbs of the circuit, a receiver hook switch at each station and means for locking the receiver hook switches at all stations except those of connected subscribers.

918,566. **Telephone System.** Ray H. Manson, Elyria, Ohio, assignor to The Dean Electric Company, Elyria, Ohio. In a signaling system, a source of signaling current, a device responsive to such signaling current, conductors for electrically connecting such device to such source of signaling current, a second electrical path between such conductors,



and means located on either side of the connection of such device to such conductors adapted to offer resistance to such signaling current varying inversely as the frequency of such current.

NEWS NOTES

FINANCIAL.

COALINGA, CAL.—The Lorene Oil Company has levied an assessment of 3 cents per share on the capital stock of the company.

WASCO, CAL.—The Fourth Extension Water Company has levied an assessment of $1 per share on the capital stock of the company.

VISALIA, CAL.—The Lindsey Heights Water Company has levied an assessment of $3.50 per share on the capital stock of the company.

SAN LUIS OBISPO, Cal.—The Huasna Petroleum Company has levied an assessment of ½ per cent per share on the capital stock of the company.

PALO ALTO, CAL.—An election will be held in this city on May 22d to decide on the issuance of bonds to the amount of $53,000 for public improvements. A municipal street lighting system costing $3,000 is contemplated in the improvements.

SAN DIEGO, CAL.—The San Diego Gas & Electric Co. has increased its capital stock from $1,500,000 to $3,500,000. The bonded indebtedness of the company is increased to $6,000,000. Extensive improvements are soon to be made to the company's plant.

BAKERSFIELD, CAL.—The directors of the Associated Oil Company held a special meeting this week and voted a $25,000,000 bond issue. A pipe line from Coalinga to San Francisco Bay, another from McKittrick, in the middle of the west side oil fields of Kern County, to Gaviota, where the Associated refinery is situated, and a new tankship, are the improvements in contemplation at the present time. The pipe for the Coalinga line, which is 8-inch rifled, has been ordered and the new work will be started immediately. This construction work will represent an outlay of $6,000,000. The remaining $19,000,000 of the issue will be kept in the treasury for future use.

INCORPORATIONS.

LOS ANGELES, CAL.—The Texas Oil Company has been incorporated here with a capital stock of $150,000 by W. E. Noble, A. H. Smith and L. C. Russell.

FRESNO, CAL.—The Coalinga-London Oil Company has been incorporated here with a capital stock of $20,000 by W. E. Reilly, S. R. Adams and A. B. Shaw.

SAN FRANCISCO, CAL.—The Enos Oil Company has been incorporated here with a capital stock of $500,000 by W. A. Irwin, John Baker Jr. and J. C. McKinstry.

SAN FRANCISCO, CAL.—The Cholame Oil Company has been incorporated with a capital stock of $2,000,000 by H. B. Hayden, J. W. Cook, C. E. Gilman and E. L. Brune.

HANFORD, CAL.—The Valley Water Company has been incorporated here by A. Guthrie, J. A. Robertson, Edward Kauntze, F. P. Hooper, W. M. Graham and W. H. Hart.

SAN LUIS OBISPO, CAL.—The Indian Valley Oil Company has been incorporated here with a capital stock of $50,000 by E. Bergemann, J. F. Densmort and J. A. Johnson.

BAKERSFIELD, CAL.—The W. T. & M. Oil Company has been incorporated here with a capital stock of $500,000 by H. W. Thomas, W. B. Beaizley, H. E. Wright, W. M. Morris and T. M. Young.

SAN FRANCISCO, CAL.—The Cuyama Consolidated Oil Company has been incorporated here with a capital stock of $500,000 by E. A. Mero, E. C. Doherty and R. F. Marcum.

VENTURA, CAL.—The Hill Top Oil Company has been incorporated here with a capital stock of $100,000 by H. H. Younken, M. H. Butcher, Ira Martin, C. J. Mallard and others.

REDLANDS, CAL.—The Gladysta Mutual Water Company has been incorporated here with a capital stock of $10,000 by G. R. Stone, E. P. Whitney, W. C. Warner, H. A. Hargraves and others.

LOS ANGELES, CAL.—The Pacific Crude Oil Company has been incorporated here with a capital stock of $1,000,000 by M. P. White, G. E. Averill, F. D. McClure, J. R. Riggins and W. H. Shaw

HANFORD, CAL.—The Tulare Lake Irrigation Power Company has been incorporated here with a capital stock of $2,000,000 by A. C. Palladine, B. R. Palladine, J. W. Barbour, T. L. Hannah and C. W. Barrett.

SACRAMENTO, CAL.—The Sacramento & Sierra Railroad Company has been incorporated here with a capital stock of $1,000,000 by Charles A. Smith, Frederick A. Warner, Frederick H. Pierce, Harry Thorpe, Arthur E. Miller and Thomas Stevenson. The new road, which will be operated either by electricity or gasoline, will connect this city with Lake Tahoe. Work on the road between this city and the Orangevale Bluffs will begin before the end of May.

TRANSMISSION.

EUREKA, CAL.—Jesse Knight will construct an electric power plant in Santaquin Canyon, for operation of his smelter.

HOLLISTER, CAL.—Bids will be received by the Board of Supervisors up till May 17th for a power line franchise in this city.

HOLLISTER, CAL.—The San Benito Light & Power Company has begun work on the construction of its new power line from Logan to Hollister.

LOS ANGELES, CAL.—Bids are being received by the Board of Supervisors for furnishing this city with four 20 horsepower and four 10 horsepower direct current motors.

RED BLUFF, CAL.—Frank K. Wilson, representing the Sierra Power Company, has been granted a franchise to construct power lines along public highways in Tehama county.

OAKLAND, CAL.—The Great Western Power Company has let a $45,000 contract to the Thompson-Starrett Construction Company for the construction of a steel sub-station in this city.

SANTA ROSA, CAL.—The Snow Water & Power Company has awarded a contract to G. W. Nelson to construct 17.58 miles of electric line from Fulton to Guerneville at $300 per mile.

NEVADA CITY, CAL.—Dr. A. J. Tickell has filed claim for 50,000 inches of water in the Middle Yuba river for the purpose of generating electric power. He proposes to erect a large electric power plant on the river just above the Plumbago Mining Company's dam, where he will generate at least 500 horsepower. By this project the entire Graniteville, Allegheny and Forest district can easily be covered by power lines.

WATSONVILLE, CAL.—The Coast Light & Power Company is at work on its new line from this city to San Juan. In another week the company expects that this extension will be completed and the improvements on the Freedom and Green Valley lines will be commenced. The extension of the system from San Juan to Hollister is in the hands of the Hollister Light & Power Company, which company was recently purchased by M. Waller, of San Francisco.

TONOPAH, NEV.—The Nevada-California Power Company announces that by the latter part of May electric power will be in use at Pioneer. Contracts were closed last week with the Bullfrog-Pioneer Mining & Leasing Company to install a 50 horsepower electric hoist.

TRANSPORTATION.

MESA, ARIZ.—A franchise has been granted A. J. Chandler to construct an electric street railway in this city.

LOS ANGELES, CAL.—The Ontario & San Antonio Heights Railway Company has secured rights-of-way for ifs electric road between Uplands and Claremount, which it is estimated will cost $175,000.

SANTA ANA, CAL.—The Los Angeles-Pacific Electric Railway interests have signed a contract with the Southern California Sugar Company, whereby it binds itself to complete the electric road between Santa Ana and Huntington Beach before July 1st.

OAKLAND, CAL.—The Oakland Traction Company, on May 2d put in effect i's new timetable on the Haywards, College and Shattuck avenue lines. Hereafter the Haywards cars will make their terminus at Twelfth and Broadway instead of Berkeley. The College and Shattuck avenue lines follow a shuttle system, each line alternating on the two streets, the terminals being Seventh and Broadway and Berkeley.

OAKLAND, CAL.—This week the San Francisco, Oakland & San Jose Railway Company began work on the construction of its Poplar street line, which will tap the central Oakland district. This extension is planned to be completed by the first of July, when single cars will form the connection with Broadway until regular train service is inaugurated. sixteen new cars, with a capacity of ninety passengers, are being constrncted at the company's shops at Emeryville

OIL.

COALINGA, CAL.—It is understood that John A. Bunting has sold the west half of the Shawmut Oil Company's property to John M. Wright of the Coalinga Peerless Oil Company.

COALINGA, CAL.—The Lucile Oil Company held a meeting this week and made several changes in the officers of the company. The vacancy caused by the resignation of Professor Carl Plehn, was filled by electing J. R. Webb. Secretary H. K. Palmer, who also resigned recently, was succeeded by J. R. Davis. A new oil cleaning system, called the Speed system, has been installed and has proven highly satisfactory for the first unit. A second unit is being installed this week and a third will be put in soon. Each unit is capable of handling 500 barrels per day. With the three units the company will be enabled to clean 1,500 barrels per day. The company has about 40,000 barrels of oil in its sumps, which will be taken away at once by the Associated Oil Company on its contract at 55 cents per barrel. There is still about 150,000 barrels to be delivered.

WATER.

LONG BEACH, CAL.—The Long Beach Water Company has awarded a contract to the Lacey Manufacturing Company, for $14,120, to furnish steel for the construction of the American avenue cement pipe line.

SAN LUIS OBISPO, CAL.—Bids will be received by the Board of Trustees up till May 10, 1909, for furnishing this city water pipe and fittings.

SAN DIEGO, CAL. The Board of Public Works has passed a resolution recommending the City Council to adopt an ordinance appropriating $72,133.13 to lay water mains in various sections of the city.

OAKLAND, CAL.—Extension of the new auxiliary fire fighting salt water pumping plant to include the most hazardous section of the business district has been recommended by the Board of Public Works to the City Council for the necessary appropriation. The pumping station at Lake Merritt is nearly completed. Two engines, aggregating 600 horsepower, are ready for installation. There is space in the station for a third engine of 300 horsepower. At its capacity the power will equal on direct pressure the work of 18 to 20 of the average steam fire engines used in this city. The two engines to be installed at the station will equal the work of 12 fire engines. The streams will be powerful enough to throw over the highest building in the business district. Standpipes will be set at intervals throughout the protected district and the water will be pumped directly. They will be powerful enough to smash through an ordinary brick wall, if necessary, to hit into the heart of a burning structure. Besides this arrangement has been made to extend the spur pipe to the water's edge on the estuary, to which any one of the half dozen fire boats in the harbor can attach, in case of need, and supply an enormous additional pumping capacity from the estuary waters. This will be of vast protective benefit in case of conflagration in the lumber yard and mill district along the water front. The volume of water thus made available will be so great that fear of a general destrnctive fire will be almost nullified.

TELEPHONE AND TELEGRAPH.

LENTS, ORE.—A telephone and construction company has been formed here by A. J. Marshall.

JACKSONVILLE, ORE.—The Citizens Telephone Comany has been granted a 20 years' franchise.

BAKER CITY, ORE.—J. L. Bisher bas a franchise for a telephone line between Richland and Robinett.

SALEM, ORE.—The Mehama Telephone Company of this county has filed a petition in the county court asking permission to build a number of telephone lines.

STEVENSVILLE, MONT.—Operations are soon to be begun by the Montana Independent Telephone Company, who will connect Stevensville with Missonla.

RENO, NEV.—The Postal Telegraph-Cable Company has begun operations for the extension of its lines from Reno to San Francisco by filing a suit for the condemnation of rights of way on land belonging to the Southern Pacific and Central Pacific Railroads across the State of Nevada.

BAKERSFIELD, CAL.—The Farmers' Mutual Telephone Association has been incorporated to take charge of several of the farmers' lines in this locality and insure better service. The company is capitalized at $4,000 and the incorporators are W. W. Frazier, R. S. Ashes, D. Hirshfield, Milo G. McKee and James Herod.

RIVERSIDE, CAL.—The incorporation of a new company to be known as the Corono Union Telephone Company, has just been announced. The company is capitalized at $25,000, and the incorporators are J. G. Jameson, E. J. Generaux, G. E. Snedecor, C. M. Scoville, W. L. Peeler, H. A. Prizer and Daniel Lord.

ILLUMINATION.

COALINGA, CAL.—A. W. Smith and S. H. Hain were this week granted a gas franchise in this city.

SAN DIEGO, CAL.—A contract for installing ornamental light posts on certain public thoroughfares in this city has been awarded to the Standard Iron Works, of San Diego.

PASADENA, CAL.—The City Council has passed an ordinance authorizing the purchase of $45,000 worth of engines, generators and other electrical machinery for the proposed municipal lighting plant in this city.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public — the consumer — who will listen with a willing and eager ear to the story of quality.
Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

ADAPTERS

Lamp Adapters
American Eveready Co.
Benjamin Electric Mfg. Co.
Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Perkins Elec. SwtchMfg.Co.

ALARMS.

Burglar Alarms
Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc.
Western Electric Co.

Fire Alarms
Edwards & Co.
Partrick,Carter&WilkinsCo.
Western Electric Co.

Water Alarms
Partrick,Carter&WilkinsCo.

ANCHORS

Johns-Manville Co., H. W., "J. W."
Kierulff, B. F. Jr. & Co., "Hubbard."
Klein & Sons, Mathias.

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Edwards & Co.
Elec. Goods Mfg. Co., "Ross," "Rivol," "Perfect," "Noxall."
Patrick, Carter & Wilkins Co., "King."
Standard Elec. Works, "C. & S."
Stanley & Patterson, Inc.
Telephone & Elec.Equip.Co. "Holtzer-Cabot & Co."
Western Electric Co.

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American Cross Arm Co. "Walworth & Neville."
California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

Mast Arms
Elec. Appliance Co., "Cutter."
Ft. Wayne Electrical Wks
Kierulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher."

Desk Phone Arms
Dean Electric Co.
Electric Appliance Co., "Eaco."
Kierulff, B. F., Jr. & Co., "Sterling."

INDEX TO ADVERTISEMENTS

Sterling Elec. Co.
Western Elec. Co.

ASBESTOS

Johns-Manville Co., H. W.

AUTOMOBILE ACCESSORIES

American Eveready Co., "Ever Ready."

BATTERIES

Dry Batteries

American Eveready Co., "Ever Ready" and "Crescent."
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Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Standard Electric Works, "Standard."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

Dry Battery Holders

Brooks-Follis Elec. Corp.
Stanley & Patterson, Inc., "Patterson."

Medical Batteries

Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Electro - tonic," "Vetter."

Wet Batteries

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Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

Storage Batteries

Elec. Storage Battery Co.
Westinghouse Machine Co.

BELLS

Electric Bells

Brooks-Follis Elec. Corp.
Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

Electro-Mechanical Gongs

Brooks-Follis Elec. Corp.
Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.

Magneto Bells

Brooks-Follis Elec. Corp.
Dean Electric Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Switchboard & Supply Co.
Standard Electric Works, "C. & S."
Western Electric Co.

BOILERS

Henshaw, Bulkley & Co.
Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, "Edge Moor."

BOXES

Floor and Outlet

Krantz, H., Mfg. Co.

Junction Boxes

Krantz Mfg. Co., H.

Wall Boxes

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Benjamin Elec. Mfg. Co.
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Electric Goods Mfg. Co., "Advance."
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Krantz, H., Mfg. Co.

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Kierulff, B. F., Jr. & Co., "National."
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Dean Electric Co.
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Arc Light Carbons
Brooks-Follis Elec. Corp. "Siemens."
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CIRCUIT BREAKERS

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Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

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Chase - Shawmut Co., "Shawmut."

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Paiste Co., H. T. "Perma-Effect."
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Blake Signal & Mfg. Co.
Brooks-Follis Elec. Corp.

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Western Elec. Co., "Thomas."

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CONDUIT

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Pierson, Roeding & Co., "Fibre."
Roebling's Sons Co., J. A., "Bituminized Fiber."
Western Electric Co. "Walworth & Neville."

CONNECTORS

Cable Connectors
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Standard Und. Cable Co.
Western Elec. Co., "Victor."

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Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Dean Electric Co.
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Safety Ins. Wire and Cable Co.
Simplex Elec. Co.
Western Elec. Co., "Victor."

CROSS ARM BRACES.

Benicia Iron Works.
Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co.

CLUSTERS

Fixture Clusters
Benjamin Electric Mfg. Co. "Anti-Night."
Dale Co.
General Electric Co.
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Ft. Wayne Elec. Works.
General Electric Co.

Incandescent Cut-Outs
Bryant Electric Co.
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General Electric Co.
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Paiste Co., H. T., "Shaffer," "K. W.," "P. K.," "Taplets."
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Weber Elec. Co., H. D. Sears, general sales agent.
Westghse Elec. & Mfg. Co.

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D. & W. Fuse Co.
General Electric Co.
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Westghse Elec. & Mfg. Co.

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A. C. Dynamos
Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

D. C. Dynamos
Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.
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American Eveready Co., "Ever Ready."

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Hunt, Mirk & Co., "Westinghouse."
Standard Engineering Co.
Tracy Engineering Co., The
Westinghouse Machine Co.

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A. C. Portable Fans
Brooks-Follis Elec. Corp.
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Standard Electric Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

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General Electric Co.,"G. E."
Sprague Electric Co., "Lundell."
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Western Electric Co., "Hawthorne."
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Westghse Elec. & Mfg. Co.

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Sterling Electric Co.

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Enclosed Fuses and Fittings
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General Electric Co.
Johns-Manville Co., H. W., "Noark."
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

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Krantz, H., Mfg. Co.

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General Electric Co.
Johns-Manville Co., H. W. "Electrotherm."
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Vulcan Elec. Heating Co. "Vulcan."
Westghse Elec. & Mfg. Co

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General Electric Co.
Kierulff, B. F., Jr. & Co "Cutter."
Western Elec. Co., "Fletcher."

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Brookfield Glass Company "Brookfield."
Elec. Appliance Co., "Hemingray."
Pierson, Roeding & Co "Locke Triple Petticoat.
Roebling's Sons Co., John A., "Knowles."
Standard Electrical Works "Standard."
Western Elec. Co., "Brookfield."

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General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co "Ohio Brass."
Pass & Seymour.
Pierson, Roeding & Co "Locke."
Roebling's Sons Co., John A., "Lima."
Thomas & Sons Co., R.
Western Elec. Co., "Thomas."

Porcelain Insulators
General Electric Co.
Johns-Manville Co., H. W.
Pass & Seymour
Pierson, Roeding & Co "Locke."
Standard Electrical Works "Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Electric Co., H. D. Sears, gen'l sales agent
Western Elec. Co., "Thomas."

Wood Knobs
Blake Signal & Mfg. Co.

INSULATING MATERIAL
Belden Manufacturing Co
Brooks-Follis Elec. Corp
Kierulff, B. F., Jr. & Co "Di-electric."

Johns-Manville Co., H. W. "Asbestos Wood," "Indurated Fibre," "Vulcabeston," "Monarch Phoenix," "Electrobeston."
Paraffine Paint Co., Agents "P. & B." Products.
Standard Underground Cable Co., "Ozite."

LAMPS.

Electric Arc Lamps
Brooks-Follis Elec. Corp.
Elec. Appliance Company "Adams-Bagnall."
Ft. Wayne Electric Works "Wood."
General Electric Co., "G. E."
Standard Electrical Works, "Jandus," "Boulevard."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

Flaming Arc Lamps
Brooks-Follis Elec. Corp.
General Electric Co., "G. I."
Western Elec. Co., "Victor."
Westghse Elec. & Mfg. Co.

Incandescent Lamps
Brooks-Follis Elec. Corp. "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co. "California."
Elec. Appliance Co., "Packard."
General Elec. Co., "Edison," "Lowatt."
Johns-Manville Co., H. W. "Linolite."
Kieruff, B. F. Jr. & Co. "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc. Lamp Co. "Sunbeam," "Regal."
Western Electric Co., "Sunbeam," "Regal."
Westghse Elec. & Mfg. Co. "Westinghouse."

Miniature Lamps.
American Eveready Co. "Ever Ready."

Tantalum Lamps
Bryan-Marsh Co., "Imperial."
General Elec. Co., "Meridian," "Tantalum."
Kieruff, B. F., Jr. & Co. "Excelsior."
Sunbeam Inc. Lamp Co. "Sunbeam."
Western Electric Co., "Sunbeam."

Tungsten Lamps
Brooks-Follis Elec. Corp. "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co. "California."
Elec. Appliance Co., "Packard."
General Electric Co.
Johns-Manville Co., H. W.
Kieruff, B. F., Jr. & Co. "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc. Lamp Co. "Sunbeam."
Western Electric Co., "Sunbeam."
Westghse Elec. & Mfg. Co.

LINE MATERIAL.

Street Ry. Line Material
General Electric Co.
Johns-Manville Co., H. W. "J-M."
Kieruff, B. F., Jr. & Co. "Lord Electric Co."
Pierson, Roeding & Co. [illegible] Brass Co.
Western Elec. Co., "[illegible]trose."
Westghse Elec. & Mfg. Co.

MACHINES.

Refrigerating Machines
Vulcan Iron Works

MINING.

Mining Machinery
General Electric Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C.
Westghse Elec. & Mfg. Co.
Western Electric Co.

METERS

Ammeters and Voltmeters
American Eveready Co., "Every Ready."
Ft. Wayne Elec. Works, "Wood."
General Electric Co.
Johns-Manville Co., H. W., "Victor Combination."
Western Electric Co.
Westghse Elec. & Mfg. Co.
Weston Elec. Instmt. Co.

Gas Meters
Pacific Meter Co.

Wattmeters
Duncan Elec. Mfg. Co., "Duncan," "Monetary."
Electric Appliance Co., "Sangamo."
Ft. Wayne Electric Works.
General Electric Co.
Johns-Manville Co., H. W.
Weston Elec. Instmt. Co.
Westghse Elec. & Mfg. Co.

MOTORS

A. C. Motors
General Electric Co.
Kierulff, Jr., & Co., B. F., "Ideal."
Standard Electrical Works, "Century."
Telephone & Elec Equip.Co. "Holtzer-Cabot."
Western Electric Co.
Westghse Elec. & Mfg. Co.

D. C. Motors
Elec. Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co.
Standard Electrical Works, "Century"
Telephone & Elec.Equip.Co. "Holtzer-Cabot."
Western Electric Co.
Westghse Elec. & Mfg. Co

MOULDING
American Circular Loom Co., "Lutz."
Johns-Manville Co., H. W., "Electrobestos."

PAINTS.

Insulating Paint
Kierulff, B. F., Jr. & Co., "Di-electric."
Paraffine Paint Co., The, "P & B."
Standard Underground Cable Co., "Ozite"

PINS

Iron Pins
Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Hubbard."
Pierson, Roeding & Co., "Locke."
Roebling & Sons Co., J. A., "Lima."
Thomas & Sons Co., The R., "Lee."
Western Electric Co.,"Lee." "Fletcher."

Wood Pins
Kierulff, B. F., Jr. & Co.
Pierson, Roeding & Co., Eucalyptus and Locust.

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Iron and Steel Pipe.
Shaw-Batcher Co., The

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Attachment Plugs.
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Brooks-Follis Elec. Corp.
Bryant Electric Co.
Electric Goods Mfg. Co., "Howes."
General Electric Co.
Hubbell, Harvey
Paiste Co., H. T., "Pushin."
Pass & Seymour.
Stanley & Patterson, Inc., "New Code."

Flush Plugs
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Bryant Electric Co., "Chapman."
Cutter Co., The
General Electric Co.
Hubbell, Harvey
Pass & Seymour
Stanley & Patterson, Inc., "Simplex."

Stage Plugs
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General Electric Co.
Stanley & Patterson, Inc., "Fielding."
Standard Electrical Works, "Kleigle."
Western Elec. Co., "Krueger."

POLES.

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California Pole & Piling Co.
Kierulff, B. F., Jr. & Co., "Tripartite."
Pierson, Roeding & Co.

Wood Poles
California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Sterling Electric Co.
Western Electric Co.

PUMPS.

Centrifugal Pumps
Goeritz & Co., O. C.

Turbine Pumps
Goeritz & Co., O. C.

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Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.
Pass & Seymour.
Western Electric Co., "Edwards," "Midget, Jr.," "New Mite."

RAIL BONDS.
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General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Thomas."
Pierson, Roeding & Co.
Roebling's Sons Co., J. A.
Westghse Elec. & Mfg. Co.

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Westghse. Elec. & Mfg. Co., "Cooper-Hewitt."

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Field Rheostats
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General Elec. Co.
Simplex Elec. Heating Co.
Standard Electrical Works, "Union."

Motor Starters
Ft. Wayne Elec. Works.
General Elec. Co.
Standard Electrical Works. "Union."
Westghse Elec. & Mfg. Co.

SEARCHLIGHTS
Ft. Wayne Elec. Works
General Elec. Co.
Std. Elec. Wks, "Engberg."

SHADES
Benjamin Elec. & Mfg. Co.
Dale Co.
Elec. Appliance Co., "Cutter."
Holophane Co.
Hubbell, Harvey.
Pass & Seymour.
Western Electric Co.,"Marten."

SOCKETS

Including all classes of Sockets and Receptacles.
American Eveready Co., "Ever Ready."
Benjamin Elec. and Mfg. Co., "Twin Socket," "Benco," W. P. Socket.
Bryant Elec. Co. "Bryant."
General Elec. Co.,"Edison."
Hubbell, Harvey, "Hubbell Pull Socket."
Johns-Manville Co., H. W., Moulded Mica W. P. Sockets
Paiste Co. H. T., "Fielding" and "Holoshade."
Pass & Seymour.
Perkins Elec. Swch Mfg Co.
Stanley & Patterson, Inc., "New Code" W. P.
Weber Electric Co., H. D. Sears, gen'l sales agent.

SOLDERING MATERIAL

Self-Fluxing Solder
Belden Manufacturing Co.
Dean Electric Co.—"1900."
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "Dielectric."
Western Electric Co.

Soldering Paste
Belden Manufacturing Co.
Blake Signal & Mfg. Co., "Aluminum Tube."
Chase-Shawmut Co., "Red E."
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F., Jr. & Co., "Dielectric."
Standard Electrical Works, "Standard."
Western Elec. Co., "Hawthorne."

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A MODERN UNIVERSITY POWER PLANT.

BY GEO. H. TINKER.[1]

Owing to the addition of several new buildings and to meet the constantly growing demands of the University of Washington, the large State institution of learning at Seattle, Washington, it was found necessary to greatly increase the mechanical equipment, and for reasons of economy and convenience of operation, as well as for the advantages it would offer along educational lines, it was decided to build a complete new power plant for furnishing light, heat and power.

Fig. 1. Power Plant of the University of Washington.

The power plant shown in Fig. 1 is located on the east side of the university campus, close to and overlooking Lake Washington, a large body of fresh water noted for its beautiful scenery.

The building is of pleasing design and of modern brick and concrete construction. It contains a complete equipment of modern mechanical devices for the economical generation of power, lighting, ventilating and heating and other requirements of a large educational establishment.

The power house is divided into engine and boiler rooms, the latter being 46′ 6″ by 41′ 4″ in size and provided with a brick chimney 54″ diameter by 100′ high erected on a concrete base.

BOILER ROOM.

A spur track of the Northern Pacific Railroad leads to the power plant, and coal is received in a

[1] Chief Engineer Hallidie Machinery Company, Seattle, Washington.

concrete bin, as will be seen in Fig. 2. This storage bin has a capacity of 500 tons.

Coal is handled from the receiving bins, to bunkers, located above the stokers, by means of conveyor shown in Fig. 3, driven by motor located in the building.

There has been installed for present needs two Parker water tube boilers set in one battery, each boiler having 2672 square feet of heating surface and designed to operate at 160 pounds safe working pressure. Pressed brick is used in the settings, which are laid in cement mortar, and great care has been used to make a model installation throughout.

Each boiler has a single steam drum 54" in diameter by 20' long and ½" thick and 128 mild steel tubes 4" in diameter by 18' long, with uptakes and drum nipples. Each boiler is equipped with an 8" delivery nozzle, two 3½ Ashton No. 3 pop safety valves and complete boiler trimmings of latest pattern.

A grate area of 58½ square feet active surface in a Green chain grate stoker is provided in each boiler. A water back of extra heavy design is provided, with water supply and drain pipes. Almost perfect combustion is obtained in the regular operation of this plant, and it is only on very rare occasions, due to starting fire under boilers or something similar that any smoke at all is visible. The driving power for stokers is furnished by a small vertical Hallidie engine set on light steel platform overhead. This engine is belted to shaft over stokers which are eccentric driven (See Figs. 4 and 5).

At the rear of the boilers is located the breeching which carries the flue gases to the stack. The breeching is made amply large to accommodate an additional boiler unit to be installed in the future, a flue opening 24" x 54" blanked off, having been provided for future boiler. Each boiler connection is furnished with a damper operated from the front of boilers as shown in Fig. 5.

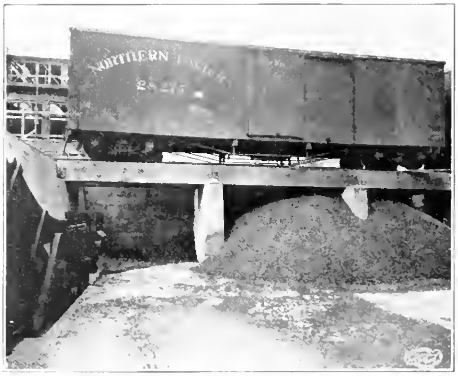

Fig. 2. Coal Storage Capacity 500 Tons.

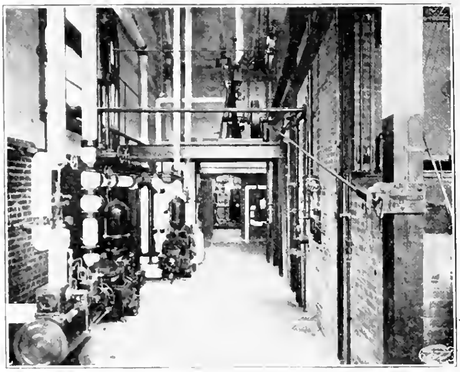

Fig. 4. Elevated Engine for Operating Stokers.

Fig. 3. Motor-Driven Coal-Conveyor.

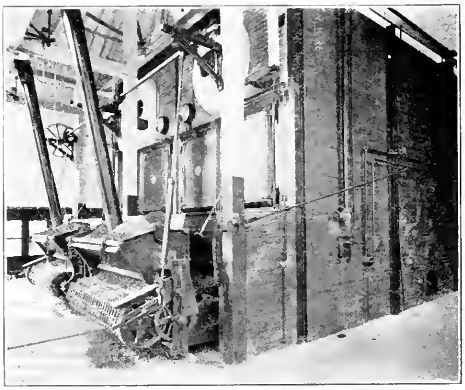

Fig. 5. Operation of Stokers.

COAL AND ASH HANDLING.

As stated before, the coal is unloaded from bottom or side dump cars in receiving bin. It is then elevated to bunkers which can be seen in Fig. 6, which also shows the conveyor and the piping arrangement on top of boilers. The bunkers have a capacity of 30 tons and from each a delivery spout provided with cut-off gate serves the coal to each stoker. The coal conveyor is driven by a 5-horsepower Westinghouse

motor, with starting box located on boiler-room floor.

From the chain grates the ashes drop into a concrete tunnel under the boilers, from where they are "sluiced" out through the east wall of boiler house

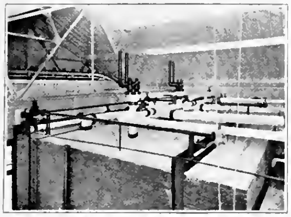

Fig. 6. Coal Conveyor and Piping Arrangement on Top of Boilers.

and through a chute down the lake bank. Water is pumped by electric power from Lake Washington for the requirements of the University. But a surprisingly small quantity is required to "sluice" the ashes away, and as the water valves and nozzles are located in the boiler room, this makes an altogether convenient, clean and inexpensive method of getting rid of all ashes.

The boiler feed water is mainly secured from the returns of the heating system, augmented when necessary from the supply secured from Lake Washington. Return water is collected in a receiving tank located in tank room on east side of building (See Fig. 7). This tank is 36 inches in diameter by ten feet long, made of 1/4 inch steel, mounted on concrete saddles and fitted with overflow, vent, inlet, suction, automatic pump control manhole, etc. The return pump shown in Fig. 7 is a 10 x 6 x 12 American outside packed plunger pump, made by the American Steam Pump Co., steam end lagged with 85 per cent magnesium blocks covered with Russian iron held on with polished brass bands and brass heads. Pump is fitted with Hills-McCanna mechanical lubricator with all attachments. The discharge from pump is connected to feed water inlet of heater, also cross connected to feed wàter piping direct to boilers.

Fig. 7. Collecting Tank for Return Water.

A 750-horsepower Cochrane feed water heater and receiver, made by the Harrison Safety Boiler Works, is provided.

This heater is located in a corner of boiler room near boiler feed pumps shown in Fig. 4. An average temperature of 210 degrees is maintained in heater. A 2½ inch pressure water system is provided in the power house for fire protection, with hose and nozzles on "Howard hose racks."

All low pressure piping, return piping, drips and blow off piping are placed in trenches, on separated rollers. Removable trench covers are 3/8 inch diamond plate and all piping arranged so as to allow for setting up or taking out of connecting bolts at any time.

All high pressure piping is extra heavy with standard "V" threads made into flanges, flush and peened out solid. All valves and fittings are extra heavy, with tongue and groove flanges and bolted with standard number and size of bolts for 250 pounds pressure. All gaskets are of copper.

All piping is supported by wrought steel strap hangers on rollers with brackets to allow of expansion in all directions. All oily drips are piped to a common 6-inch main leading to a water seal in receiving tank room, from where they are discharged into the sewer.

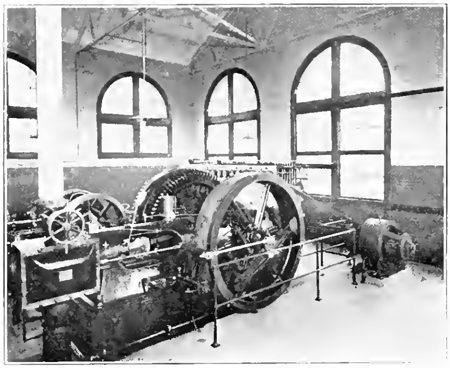

Fig. 8. Engine Room of Power Plant.

Two outside packed plunger boiler feed pumps of the American Steam Pump Co. make, size 12 x 6 x 12 inches, fitted with Hills-McCanna mechanical lubricating devices and Copes automatic pump governors are installed. Steam ends are jacketed in the same manner as that on return pump already described.

THE ENGINES.

The engine room presents a pleasing appearance. It is 32 feet 3 inches by 46 feet 6 inches in size, with lofty ceiling and plenty of light and ventilation. The floors are of concrete with smooth hard finish.

Two horizontal simple generating units are installed. These are Ridgway engines, made by the Ridgway Dynamo & Engine Co., direct connected to 100 kilowatt and 200 kilowatt generators, respectively. These engines (See Figs. 8 and 9) have cylinders 10 x 20 inches and 14 x 14 inches, and run at 200 and 300 revolutions per minute respectively.

Each engine is fitted with Ridgway improved tank oiling system, and Hills-McCanna lubricating devices, with nickle plated piping. Two complete sets of Thompson steam engine indicators with reducing motion, all in handsome hardwood cases are provided.

Engines are fitted with complete synchronizing mechanism operating on the "Begtrup" inertia governors for adjusting speed from the switchboard.

The engines receive their steam from the main steam header on the boiler room side of dividing wall, as shown in Fig 9. Cochrane steam seperators are placed in steam lines and connected with traps located in boiler room. The engines exhaust into an 18-inch exhaust main placed in a concrete trench and leading to the steam heating system for supplying heat to University buildings. Atmospheric exhaust, back pressure valve and 18-inch gate valve on heating main can be seen in Fig. 9.

On a handsome marble guage board in engine room are mounted the Schaeffer & Budenburg steam gauges, heating and receiving gauges and duplex gauge for checking the Davis reducing valve shown in Fig. 10.

in parallel at 2300 volts. The rotating parts are built upon a spider, which is solid and arranged to be pressed on engine shaft. The external frame is solid and movable parallel to the shaft to allow of access to the windings, as can be noted in Fig. 9. Armatures of these machines are of the slotted drum type and the core is built of laminated steel of high magnetic quality. Throughout the armature spider, core and windings, large and open ventilating ducts are provided, the design being such as to set up a forced circulation of air through these ventilating spaces. During the rigid test of the plant continuing through several days, frequently with 50 per cent overload, these generators, as also the engines, ran remarkably cool.

The switchboard, consisting of seven panels, shown in Fig. 11, was also furnished the contractors by the Westinghouse Electric and Manufacturing Company. It is located in the engine room, and consists

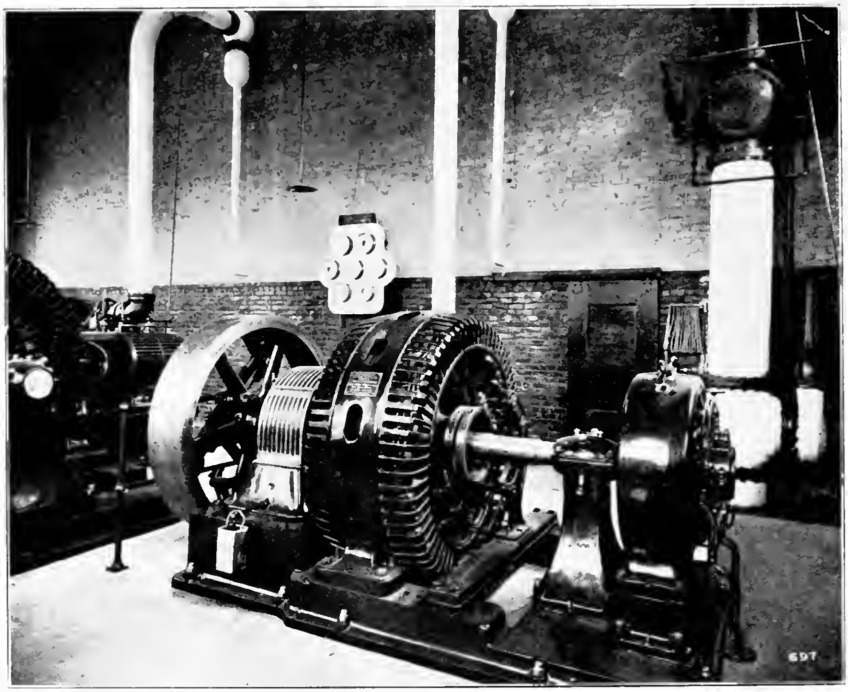

Fig. 9. Engine Room of Power Plant.

In Fig. 10 is also shown the 18-inch Cochrane oil separator to protect the heating system, also the live steam connection and the point of exit for the 18 inch exhaust main. This exhaust main is 1200 feet in length, has several branches 8 inch and 6 inch in size, to the various University buildings. All piping is insulated in redwood pipe, carried on rollers and provided at proper intervals with concrete manholes in which are placed expansion joints of special design anchored on concrete piers.

GENERATORS AND SWITCHBOARDS.

The generators are of the Westinghouse Electric & Manufacturing Company's alternating current rotating field engine type, 3-phase, 60 cycle and operate

of seven panels all of which are 24 inches wide by 96 inches high, except the two generator panels which are 32 inches wide. All oil switches and circuit breakers are mounted separately back of the board, the operating handles only being mounted on the panels, connections being made by bell cranks and connecting rods.

The switchboard is arranged for the control of two 125 volt exciters, one 100 kilowatt and one 200 kilowatt generators previously described, seven single phase lighting feeder circuits and three three-phase power feeder circuits. Mounted on brackets at left end of board are, two 3000 volt type "F" A. C. Voltmeters, one single phase synchroscope and one 3-phase power factor meter. Panel "A" on the left in Fig. 11,

controls the two exciters and the power house lighting circuits; panels "B" and "C", the generators, and on these are also mounted the switches for manipulating the synchronizing devices on engines; panels "D" and "E", control six lighting circuits; panel "F" one single phase lighting feeder and one 3-phase power

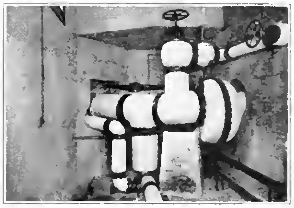

Fig. 10. Arrangement of Oil Separator and Reducing Valve.

feeder, and panel "G," which controls two 3-phase power circuits. All panels are provided with the necessary bus bars, wiring and inter-connections between instruments, switches, etc., and all switches provided with suitable terminals. All alternating current instruments for the 2200 volt circuit are provided with series transformers and all shunt instruments, such as voltmeters, synchroscope and power factor meters are provided with shunt transformers.

All wiring for generators, exciters, switchboards, etc., are placed in trenches with removable steel covers.

Under this contract was installed all of the circuits in underground ducts leading to the various University buildings. Lead covered cable was used and the whole installed in a most thorough and up-to-date manner and subjected to a severe test. The contractor also furnished and installed three 75 kilowatt oil cooled subway transformers with water tight cases. These were installed in concrete manholes.

There was also furnished under this contract one 8 inch and 13 inch by 12 inch Ridgway cross compound

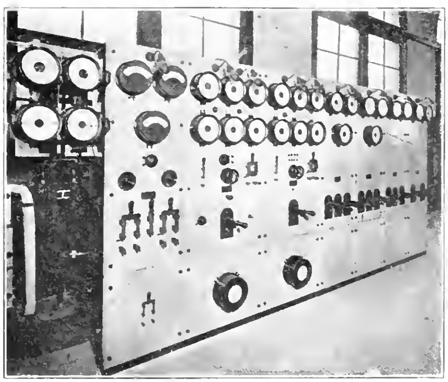

Fig. 11. Main Switchboard.

steam engine for experimental work in the new Mechanical Laboratory of the University.

All piping, fittings and valves used in this installation were furnished by the Crane Company of Chicago, Ill. All pipe covering was furnished by the H. W. Johns-Manville Co.

The entire power plant equipment, including heating and return mains, electric circuits, etc., was installed under one contract by the Hallidie Machinery Company of Seattle and Spokane, Washington,

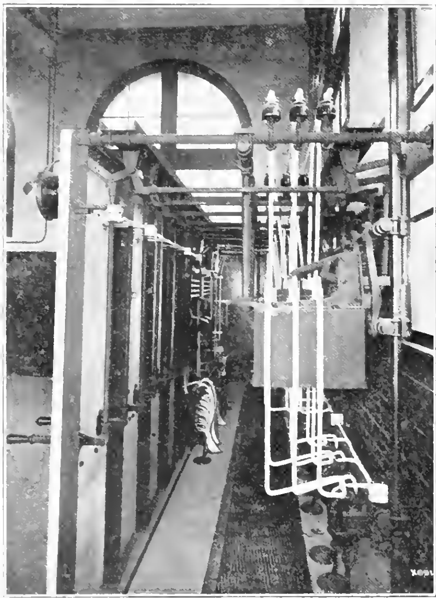

Fig. 12. Back of Main Switchboard.

under the personal supervision of Mr. H. L. Weber, the contractor's superintendent of construction. Howard and Galloway of San Francisco, were the supervising architects.

MECHANICAL AND ELECTRICAL LABORATORIES.

The foregoing mechanical and electrical apparatus supplements the following equipment of the mechanical and electrical laboratories and furnishes an object lesson to students in these branches of engineering of a thoroughly modern type of installation. The appropriation made by the Washington State Legislature provided for the construction of several other permanent buildings besides the power house to be used by the Alaska-Yukon-Pacific Exposition and to subsequently revert to the University of Washington. One of these buildings, Machinery Hall, will be occupied by the Engineering College and in addition to class rooms, drafting rooms and offices, will contain the testing laboratories of the department of mechanical engineering, and the laboratories of the department of electrical engineering.

The mechanical laboratory will contain a McEwen cross compound engine, a McEwen single cylinder engine, a Murray Corliss engine, a Ball engine, a Foos gas engine and a De Laval steam turbine. Besides these principal machines, the equipment consists of condensers, gauges, indicators, gas apparatus, barometers, thermometers, pyrometers, steam calorimeters,

fuel calorimeters, speed indicators, brakes, air compressor, air brake outfit, and such devices as may be necessary for testing and calibrating the apparatus used.

The electrical laboratory is equipped with generators and motors for both direct and alternating current.

In the D. C. section are located machines of the Westinghouse, General Electric, Bullock and Western Electric manufacture. Lamp banks, switch board; rheostats, storage batteries and other necessary apparatus are provided.

In the A. C. section are located dynamos of commercial types; a two-phase and a three-phase Fort Wayne generator; three-phase Westinghouse rotary converter; Wagner, General Electric and Bullock, single phase and three-phase induction motors and a three-phase Fort Wayne synchronous motor; transformers, lamp banks, switchboards and numerous meters. The electric equipment of the power house formerly occupied, will be added to these laboratories. Near the engineering building and the new power house will be located the shops of the mechanical engineering department, which will include departments in woodworking, machine shop and foundry practice. The foundry portion of this building will be equipped with a Whiting cupola, a Steele-Harvey brass furnace, crane, core ovens, mill, rattler, shaker, riddles, core machines and molding machines, and other accessories. One wing of this building will contain the forge shop, which will be fitted with 20 Buffalo down draft forges, a power hammer and a tempering furnace.

The entire equipment of the pattern shop and machine shop will be moved to different portions of this building.

DISTILLING TURPENTINE BY ELECTRICITY.

The attention of Consul-General George N. West has been called to a small plant in operation in Vancouver in which experiments have been carried on for several years with the view of obtaining turpentine from the resinous woods of British Columbia by an electrical process of distillation. He reviews the progress made:

The operations thus far have been carried on in a small way, only about two cords of wood or mill refuse having been treated daily. It is claimed, however, that the results have been eminently satisfactory. The turpentine, after tests by chemists and painters, who have used the product both for inside and outside work, pronounce it to be equal if not superior to the turpentine distilled from the long-leaf pine of the South. From one cord of the resinous wood treated it is claimed that the tar, oil, rosin, pitch, and charcoal (the by-products), more than pay the cost of the distilation of the turpentine, thereby making this process a valuable one.

It is claimed that from one cord of pitchy wood costing $5 there can be extracted chemically pure turpentine, tar oil, rosin, charcoal, and pitch to the aggregate value of $24.70, the present market value of these commodities, at an expense of $12, giving returns of $12.70 per cord. That this statement is not erroneous is vouched for by persons who have the most thorough knowledge of the process and cost of manufacture, they claiming that the small plant now in operation is producing the products at the price per cord stated.

The amounts of by-products said to be obtained from one cord of wood (amount of turpentine secured not being stated) are as follows: Rosin, 60 pounds; tar oil, 20 gallons; charcoal, 1,300 pounds. The oil is used for wood preservative, and is also manufactured into shingle stain. The charcoal, having been coked and cooled in a can out of contact with the air, is very perfect and valuable for making powder.

The resinous woods necessary for use in this plant are accessible in large quantities at cheap rates, not only from the many mills in Vancouver and near vicinity, but also from the standing timber that is not suitable for lumber, and can readily be procured. The plant has recently been increased to treat 40 cords of wood per day.

CURRENT COMMENT

Wireless communication was established between New York and Chicago on May 3, 1909.

Mr. Roosevelt will be about the first man to put the efficacy of a rifle fitted with electrically lighted sights for night shooting to a test, with a weapon especially given him by the United States war department for that purpose. The sights are the invention of a Chicago man.

A 12,000-candlepower lamp is another wonder. Recently an experiment was made with the "Sylveriyte" lamp, the light of which is guaranteed to penetrate the murkiest brand of fog. An electric bulb fits into the power lens of the lamp, which magnifies its 12-candlepower light up to 12,000 candlepower in a concentrated ray.

The Postal Telegraph & Telephone Employes' Association of Paris has thrown down the gage of battle to the government by forming itself into a union under the law of 1884. This places the association on the same footing with the workmen's union and gives them the right to strike. This movement on the part of the employes raises the important issue of whether the employes shall be the masters and not the servants of the state.

The first gas in Mexico will be furnished for the capital of that Republic by December 1st by the Mexican National Gas Company, a $2,500,000 Delaware corporation, formed by Los Angeles and San Francisco capitalists. The company is now buying generators, boilers and other equipments. The municipal government of Mexico City has granted the necessary concession for laying the mains in the streets and for all needed improvements. The officers and directors are: E. L. Doheny, president of the Mexican Petroleum Company, president; C. A. Canfield, first vice-president; R. H. Miner, Los Angeles, second vice-president; Norman Bridge, Los Angeles, secretary and treasurer; E. P. Ripley, president of the Santa Fe Railroad; E. C. Bradley, manager Pacific Telegraph and Telephone Company, San Francisco; W. L. Hardin, Los Angeles, and Harold Walker, Mexico City. For making the gas, crude oil from the fields of the Mexican Petroleum Company at Ebano and along the Gulf of Mexico will be used. At the start it will be delivered on the tank cars on the Mexican Central and the capacity will be 1,000,000 cubic feet, to be increased as rapidly as the demand justifies and it is expected to reach eight or nine million as a maximum.

CONSERVATION IN CALIFORNIA.

Representative of every county of California, the eleventh semi-annual meeting of the counties committee of the California Promotion Committee convened at Del Monte on May 8 to discuss the chosen theme, "Conservation in California." This was the first state meeting to consider this subject held in the United States since President Roosevelt called the conference of the governors of the states of the Union to take up the theme of conservation. A representative member of the National Conservation Commission was present at the meeting, as was also a member of the Inland Waterways Commission appointed by President Roosevelt, as well as other Federal and State officials, experts in various branches covered by the general subject of conservation, and the papers presented embodied the results of a thorough study of their subjects by those who have made a life work of them. Epitomizing the ideas in the papers and the ensuing discussion, the report of the committee on resolutions summed up, to an extent, indicated the line of effort that will be made by the Committee to carry to an effective consummation in California the movement for a better utilization of the State's natural resources and a wider appreciation of the importance of a heedful regard by the people of today of the heritage they are to leave to the people of tomorrow.

The meeting was held in the art gallery of the Hotel Del Monte, and was presided over by Andrea Sbarboro, chairman of the Counties Committee, which has met twice a year in different cities of California to discuss different matters of general State interest and importance, each session, as was the case of the Del Monte meeting, confining itself absolutely to the consideration of a single, broad subject.

William Sandholt, Jr., of Monterey, welcomed the delegates to Del Monte on behalf of the Monterey Chamber of Commerce, Pacific Grove Board of Trade, and the ladies' civic clubs of the two towns, which organizations had arranged for the reception and entertainment of the delegates.

Meeting in the Art Gallery of the Del Monte Hotel.

ADDRESS OF ANDREA SBARBORO.

Ladies and Gentlemen

The eleventh semi-annual meeting of the Counties Committee of the California Promotion Committee will please come to order.

We have the pleasure to meet today in the historical city of Monterey on the border of the Pacific ocean, in the midst of most beautiful gardens, a spot of which there are few equal on the face of the globe.

The principal subject for discussion at this meeting is one of the greatest importance—"Conservation in California."

Nature has, indeed, been generous to California, giving us such bounteous and diversified resources, as no other part of the world is blessed with. It is our sacred duty to conserve these gifts in a most careful manner.

The great forests which have been handed down

to us from thousands of years past for our enjoyment and proper use, should be conserved and handed down to our posterity for their enjoyment and proper use for thousands of years to come.

Our water resources poured on our soil from Heaven and fed by our snow-capped mountains are abundant, but we should see to it that not a drop of this precious water is wasted, but all be put to proper use.

Our agriculture should be carefully fostered. California produces to perfection all the necessaries of life, required not alone for the use of its own people, but can supply its surplus to many people in our sister states and throughout the wide world.

We should be very grateful, indeed, to our present Congress for having by a prudent protective tariff conserved our diversified products from unfair competition; and we are also grateful to our recent Legislature for having passed by unanimous vote of both the Senate and Assembly resolutions recommending the encouragement and protection of our great viticultural industry and appropriating a permanent fund of $15,000 to the State University for its conservation.

Gentlemen, this is a matter of the greatest importance to our State, both morally and commercially. Morally, because we know that in the countries which are blessed with the soil and climate that produce grapes to perfection, all the inhabitants use the healthy juice of those grapes at their meals, and as has been recently proved by our Ambassadors and United States Consuls residing in those countries as a result the people are free from the evil of intoxication.

Commercially, because as our State is one third larger than the kingdom of Italy, which gives profitable employment in the viticultural industry to over five million inhabitants, so California, with the same soil and climate, can produce the same grapes, make the same fine wine and when our people will become accustomed to drink that healthy, non-intoxicating beverage in moderation at their meals, intoxication will be removed from our midst and California will also employ in the viticultural industry five million people, thus turning our sheep hills and valleys into beautiful vineyards, creating new towns and cities throughout the State and adding a revenue of two hundred million dollars per annum to our resources.

Our citrus fruits will likely be better protected by Congress and thus aid us in finding new markets, and both the Northern and Southern part of the State will increase its production of oranges and lemons, to be shipped to many parts of the world.

Our mines, which first brought California to the attention of the world, should also be carefully protected by regulating their proper management in such a manner that gambling and wildcat schemes will be prohibited. This will encourage capital to invest in legitimate mining enterprises and result in the [illegible] development of our inexhaustible mineral resources.

The [illegible] should also be carefully regulated [illegible] waste and increase the output of this [illegible] industry.

In [illegible] I will say that California is blessed with [illegible] resources that when they will have become developed to their full capacity, with due regard to their conservation, this State will give profitable occupation and be inhabited by twenty millions of the most prosperous and happy people on the face of the globe.

Following the address of Mr. Sbarboro, the Chairman appointed the following Committees:

Committee on Credentials: Geo. B. Finnegan of Nevada county; F. N. Delanoy of Alameda county; C. A. Turner of Tulare county; T. A. Richmond of San Francisco county; Rudolph A. Wilson of San Benito county.

Committee on Resolutions: Judge Frank H. Short of Fresno county; C. A. Moody of Los Angeles county; George W. Pierce of Yolo county; George F. Roberts of Napa county; H. F. Stoll of Marin county.

If space would permit, it would be the pleasure of the "Journal" to reproduce in its entirety the many valuable papers read at this convention. Two of the papers, however, are of such general interest to the American people that we reprint them as read.

THE ECONOMIC VALUE OF IMPROVED RIVERS AND DEEPENED HARBORS.

BY JOHN A. FOX.

The complete development and utilization of our inland waterways for navigation, and the speedy and efficient improvement of our sea coast harbors are perhaps the most important of all matters that present themselves today for consideration at the hands of the American people. Before an assemblage of this character, therefore, where conservation is the theme, it is perhaps very proper that some thought be given to this subject—especially to that phase of the subject which pertains to the improvement of inland waterways.

The conservation of our water is without doubt the most imperative duty that confronts us; for in the present condition of waste, or non-utilization of natural resources, the waste of water is much more far reaching than the waste of any other natural gift. Each inch of rainfall wasted means so many millions of dollars lost in Agricultural wealth; the flow of every cubic foot of water to the sea unused means the loss of millions of dollars worth of heat, of light, of mechanical force; the unused channel of every mile of water course means an extravagance that in the aggregate costs the people of this nation many millions of dollars each year. In permitting our water to go to waste, therefore, we are losing the primal source of nearly our entire wealth.

By concerted effort as a people, as a nation, we may cause great arid and unproductive areas to yield agricultural products; we may harness the rivers and rapid flowing streams to run our workshops and haul our trains, and at the same time produce a great network of intercommunicating water routes upon which our products may be most economically transported.

It is with the transportation feature that I will deal particularly on this occasion, because that is the mission of the National River and Harbor Congress. There are at present some 45,000 miles of inland waterways traversing the United States, upon which commerce could be carried today at a great savings to the people if adequate improvements were made upon them, such as have been made upon the water-

ways of other countries. These embrace the possible navigable rivers of the Pacific coast, the 16,000 miles in the valley of the Mississippi, and about 17,000 miles of rivers from 100 to 300 miles in length penetrating the Atlantic and Gulf coasts. They are today of little or no service in transporting our freights because of the unstable and unreliable depths of water to be found in them, and, owing to conditions resulting from internal development and the advance of civilization, they are perhaps of less use today in transporting freights than they were in their natural state some 50 or 100 years ago. Prior to the settling of the plains, the clearing of the forests and the draining of the pools, silt and loosened earth that now fills the natural river beds was held by native turf; forests that no longer stand, held back and retained the waters, and vast areas now provided with modern drainage no longer feed out the even flow for a period of twelve months, but disgorge in great floods for two or three months and leave the channel dry or too shallow for navigation during the remainder of the year. All of this can and should be rectified by the national government, so that this vast natural system of water courses could again be utilized.

We are neglecting this important duty every day, and the condition of these rivers is becoming worse and worse, although many believe that the rivers and harbors of the nation have received ample funds at the hands of Congress. When you pause to consider that we are devoting only about $22,000,000 each year to this most important character of national development, while we spend $140,000,000 every year on pensions, and $110,000,000 every year on a navy, and $82,000,000 every year on an army, you, too, will conclude that this phase of our development is neglected.

Consider, moreover, what a magnificent investment this nation could make by improving these rivers for navigation. It would require an outlay of about $500,000,000 during the next ten years to construct the needed improvements on this vast system embracing the San Joaquin and the Sacramento; the Snake and the Columbia; the Missouri, the Ohio and the Mississippi; the Red and the Arkansas; the Intercostal canal and the Atlantic Deeper Waterway, and all of the other important rivers reaching nearly all parts of the country. Once improved, these waters would become capable of navigation and a vast tonnage that must now move by rail at a cost of $7.50 per ton per 1,000 miles, which was the average rate by rail last year, could be carried at a rate of $2.00 per ton per 1,000 miles, which was the highest rate on inland waterways. Now, the amount of freight carried by the railway systems last year was 236,038,000,000 tons carried one mile, so that if the waterways had been improved and had been able to carry but one-tenth of this bulk at a saving of $5.00 per ton per 1,000 miles it would have amounted to over $118,000,000, or more than 25 per cent on the entire cost. As water rates determine the rail rates, however, it would have even been more than this, and if the regulating influence that is now felt by the roads that compete with water traffic on the Great Lakes, the Ohio or the Mississippi river, can be taken as a basis, the reduction would have been $1.00 per 1,000 miles on all of the remaining freight that was carried by rail, or practically $200,000,000. It would appear then that $318,000,000 saved annually to the American people by the investment of $500,000,000 would be a very good investment. There is no doubt but what such a saving would follow these improvements for it has been demonstrated wherever we have made thorough and complete improvements to benefit navigation, for example on the Great Lakes, on the Monongahela river and along the Atlantic coast. Moreover, we have the example of the waterways of Germany, France, Belgium and the other European countries to give us some idea of what could be saved by encouraging transportation by water.

Then, too, deepening our harbors has paid for the investment many times over, and that is a work which must be extended until all of our seaports are capable of harboring vessels of a uniform draft of at least 30 feet.

A Short Stop at Pajaro.

It is estimated that all together we have as a nation expended but little over $587,000,000 in river and harbor improvements. On twelve important harbors on the Gulf and Atlantic coast we have expended but about $53,000,000, and yet the saving every year on freights that come in and go out of these harbors because of the present greater depth exceeds that entire amount many times over. In New York harbor alone there is an annual saving of nearly $82,000,000, because a 35-foot channel exists instead of the former 23-foot channel. The reduced price on the export of cotton and grain alone on account of deeper water in the Southern harbors nets the American people over $18,000,000 annually, because a 15,000-ton vessel can now replace the old 3,000-ton vessel, and charges 27 cents per 100 pounds less on cotton and 5 cents per 100 pounds less on grain than was the case before improvements were made.

Moreover, it is at least interesting to note the enormous impetus given to our commerce by these improvements, as is exemplified by a few of the Eastern and Gulf harbors. Boston harbor, deepened from 18 feet to 30 feet at a cost of $7,273,000 has increased her commerce from $66,600,000 in 1870, to $209,700,000 in 1907; New York harbor with improvements that cost only $2,146,000 has increased her commerce from $840,276,000 in 1886 to $1,163,110,000 in 1907; Norfolk's commerce has been increased by the improvement of Hampton Roads at a cost of $1,665,000 from $21,349,000 in 1890 to $597,950,000 in 1907; Mobile,

with $4,949,000 spent upon her harbor deepening it from 13 feet to 23 feet has seen her commerce grow from $3,479,000 in 1890 to $28,410,000 in 1907, and Galveston harbor, improved at a cost of $7,591,000 has shown an increase from $24,862,000 in 1890 to $244,337,000 in 1907. Nor have harbor improvements been less remunerative here on your Pacific coast, for, although in all of the harbor improvements made out here, from San Diego on the south to Bellingham on the north, only about $20,000,000 has been expended; yet so great has been the impetus given to commerce that it has increased in the aggregate from 4,062,000 tons in 1885 to 15,654,000 tons in 1907. At Oakland, California, and Portland, Oregon, the results have been most remarkable. At an expense to the national government of a little over $2,878,000, Oakland harbor entrance has been increased from five feet in 1874 to 25 feet in 1907, and as a result her commerce has expanded from 156,300 tons to 4,216,125 tons annually. In improving the entrance to the Columbia river and perfecting a channel to Portland, Oregon, about $7,286,000 has been spent, and the commerce has expanded with a growth of 4,351,000 tons in 1907 as compared with 1,637,000 tons in 1898. It has been the best investment of any $20,000,000 ever made by this nation, and more investments of this character must be made in the future if we, as a nation, are to reap the benefits to be derived from the digging of the Panama canal.

The time has come, gentlemen, when these river and harbor improvements must be carried on in a more extensive and comprehensive manner. There must be more businesslike methods pursued, larger sums appropriated and work must be done in a more continuous and less wasteful manner. Under the present system we undertake to build a breakwater estimated to cost $3,000,000, and $1,000,000 is appropriated to start the work. Half of this is used in getting ready the false work and maybe the next River and Harbor bill fails to pass Congress and by the time another bill can be passed carrying some more of the needed $3,000,000, the false work has been destroyed by teredos and must be built over again. We undertake to improve one of our rivers and contracts are let for certain locks and dams and a large amount of money is appropriated to begin the work. Congress fails to provide for this undertaking when the next River and Harbor bill is framed, and hundreds of thousands of dollars are lost in the ravages of floods and time. This must cease, and a continuous river and harbor policy must take its place, with money provided every year just as is provided for the army, the navy or the judiciary. We can only bring about such a change when the entire American people shall have been informed and made to express themselves regarding such matters. You here in California can help bring about such a change as well as the people in Illinois, or New York, or Louisiana, and with your great interest in controlling the San Joaquin and Sacramento rivers, and in having better provision made for deep water in your harbors, you should do all in your power to help agitate the question and promote such a change of policy as will insure the expenditure of not less than $50,000,000 each year by Congress until these worthy rivers are controlled and made useful for navigation and our splendid harbors are uniformly deepened for the traffic of the world.

THE CONSERVATION OF CALIFORNIA'S FORESTS.

BY F. E. OLMSTED.

In the matter of conserving its forest resources, California is vastly favored over many of the eastern states, for it has taken up this problem while there is still something to conserve. In the Lake region of the East, for example, the question is one of restoration, rather than conservation because, practically speaking, there are no forests left to conserve. Fire and ax have left the lands waste and barren, and in many cases the only way to secure a new forest is through artificial planting.

In California conditions are quite different, because here both of the great mountain ranges of the state are still fairly well covered with an excellent forest growth, and if we carefully protect and wisely use the resources now standing there is no reason why they should not be made of permanent value. Roughly speaking, the total stand of timber in California amounts to about 250 billion feet. Of this amount approximately one-half is owned by the national government and one-half by private and corporate interests. If conservatively used this stand should furnish a yield of over two billion feet annually for all time. Those forest lands owned by the national government are now fairly well protected and the policy of holding them as a source of permanent wealth is already established. The United States expends $400,000 each year for their protection and administration and employs over 400 men in this work. Up to the present time the financial returns have equaled about one half the amount expended, but next year it is expected that the income will equal the expenditure. The leading principle which permeates the whole management of national forests is that trees should be kept growing on all lands which are of chief value for the production of trees, and that this should be brought about through wise use. The national government, for example, is selling large amounts of mature timber every day, but the forest is cut in such a way as to make sure of future crops on the logged off areas; in other words, the lands are protected and left productive after lumbering instead of being abandoned to fire and becoming waste and non-productive.

The question, then, of most immediate importance in California is how to bring about favorable conditions for practical conservation of forest resources on private and corporate timber lands. The consideration of this subject is peculiar in that the way in which the forests of California are handled has a marked influence on almost all the other great industries of the state. Any discussion of this subject must, therefore, be approached not from the standpoint of the timber owner, or manufacturer; not from the standpoint of the rancher or irrigationist; not from the standpoint of the developer of water power, or the miner, or the home-builder, or the city resident; but from the standpoint of all these interests combined. They are all intimately affected, because wood will always be most essential to all of them, and because forest lands can not be laid waste and made non-productive without causing serious injury to each. The

problem then must be considered from the standpoint of the common good, with an eye to what the future will demand.

There are several leading points in the question of forest conservation which some years ago were widely argued and discussed, but which at the present time may fairly be taken for granted. They are these:

It is worth while to expend money now in order to save from destruction what we already have.

Land of chief value for the production of trees should be kept covered with trees with the greatest number and the most valuable kind of trees the land will produce.

In many cases it is essential to keep trees growing on mountain lands not only for their market value as trees but also for their value in regulating the flow of water, so vital to the prosperity of the agricultural, waterpower and other interests.

In all cases where the land should be kept in trees, the forest when cut should be handled in such a way as to get the best possible new crop in the shortest time and at the least expense.

Conditions should be made as safe and as reasonable as possible for the holding and proper harvesting of the next crop.

How can all these things be brought about?

Let us not forget that they mean one thing to the national government, or the state, and quite another thing to the private owner. The State may well afford to expend money for protection and wait comparatively long periods before it derives comparatively small returns from the harvesting of future crops. But the private owner is naturally and usually necessarily influenced by the desire for the greatest possible immediate returns, and, under existing conditions, can not often afford to handle his property with a view to small returns after comparatively long waits. Under almost all systems of conservative management which provide for continuous crops of timber the rates of interest obtained on the capital invested are considerably below those expected by the timber operator of today, who must, of course, face business conditions as he finds them.

And so it may well be a question whether the State must not eventually advise and assist in the administration of the bulk, if not all of the lands chiefly valuable for the production of timber, at least whenever the manner in which they are handled affects not only the individual owning them, but also many other important interests; and in many cases the duty of caring for such lands may necessarily fall at least partly to the State because the individual can not and should not be expected to bear the sole burden of curtailing his profits for the benefit of other interests.

The things we are working for are to protect the timber now standing, and to make the cut-over lands keep on producing timber. A most necessary measure to the protection of private timber holdings in California is a wise enforcement of the clause in the present State law which provides that:

"All lumber companies, corporations or individuals shall, when so instructed by the State Board of Forestry, and at a time and in a manner prescribed by said Board, carefully burn their slashings, by which is meant the tops, limbs and general debris left after lumbering."

The judicious application of this clause would be a long step ahead toward saving millions of dollars worth of privately owned timber from destruction. The clause might well be amended to the effect that if the directions of the State Board of Forestry are not complied with the State may do the necessary burning at the expense of the owner (under the present State law the Counties are liable in this respect for slashings along County roads). It might provide, too, that the slashings shall either be burned or "otherwise safely disposed of," for it is not always necessary or advisable to burn them.

The fire danger, therefore, could be largely removed through a wise application of the present fire law, with slight amendments. Objection to its enforcement could not be seriously considered, for it would mean, simply, that the owner or operator must use reasonable care to protect other adjacent interests just as valuable as his own. The lumbermen of the State, doubtless, would welcome the enforcement of this clause as a means of self protection.

This matter is emphasized because nothing of any value in the way of forest conservation can be brought about until the problem of protecting lands from fire is satisfactorily solved. Fire is the one great enemy which must be conquered before any practical results are possible. A vast amount of good has already been done in California through a gradual change of sentiment in this respect. Only a few years ago, for example, people were careless with camp fires and paid little or no attention to a forest fire speading over the mountains. Fires were numerous all over the State and in many cases were considered necessary. Things are quite different at present, and a forest fire is looked upon as a great calamity. This change of sentiment, of course, has been brought about by a campaign of education, which should be kept up most vigorously, for there is still room for improvement. Together with this change of sentiment should come a system of paid fire fighters. The State should be covered with men who make it their business, and their only business during the dangerous season, to watch for and fight forest fires. As in all other undertakings, organization and system in this matter are absolutely essential.

Another most useful measure would be the formation of an association among the timber owners for common protection against fire, at common expense. Such an organization is already accomplishing much in Washington, Oregon, Idaho and Montana, and there is no reason why excellent results should not follow in California.

Assuming that it is feasible to protect the timber already standing, the next question is, what can we do to bring about such conditions as will warrant the timber owner in logging his lands conservatively with the view of holding them and protecting them as a good business investment until the next crop is ready for the ax? We might do two things: First co-operate with him in protecting his lands against fire, and second, reduce the taxation on cut-over lands to such an extent as will make it profitable to hold them for the next crop of timber. Let the State and the timber owner or lumbermen's association combine and establish an efficient and a well-paid fire patrol. The trouble with the present State fire patrol

is that it is almost entirely voluntary; you can not get anything worth while without paying for it, and if the State contributes its part it means that the farmer, the miner, the waterpower developer and all the other industries affected contribute their part.

And now about taxes. Of course, the only object in reducing taxation should be to make it worth while to keep trees growing on cut-over lands. It would be foolish, would it not, to reduce or remit taxes on lands which might be slashed to pieces, burned up and made barren and non-productive for all time? A reduction in taxation, therefore, should be made only in case the timber owner agrees, in co-operation with the State, to log off his land so as to leave it in good condition for the production of another crop, and after this is done, also in co-operation with the State, to protect the coming crop against fire. In other words, does it not hold that the State is justified in helping the private owner only in case the private owner agrees to handle his property so as to give reasonable assurance that it will continue to be timber producing.

Whenever such an agreement is made the State would be justified in reducing taxes very materially on cut-over lands, or, possibly, in remitting them altogether for a period of years. Or taxes could be collected on the timber when harvested, together with a small annual tax on the land, based upon its productive value.

Of course, any considerable reduction or variation in taxation, or its abolishment altogether for a term of years, would seriously upset the financial systems of the counties concerned. To avoid this the State might pay to the counties, yearly, a sum in lieu of taxes, reimbursing itself from time to time through taxes obtained from the owner or from the crop when harvested.

But whatever plan may eventually be found wise and practicable, the chief end in view should be to provide that a reduction in taxation and assistance from the State in protection should be accompanied by such methods of lumbering and such organized protection as will make it reasonably sure that the lands will continue to produce trees instead of becoming waste and non-productive. In the vast majority of cases we can keep trees growing through a natural seeding up of the area from those trees left standing after logging. This is proved by a hundred years of forest management in various countries throughout the world, and by 15 years of practical operations on the national forests of this country. In some few cases, artificial planting must be done, but this is expensive, as yet rather uncertain of success, and demands the most intensive and costly kind of protection. Where we can not get a natural re-growth we should by all means plant artificially, but not otherwise. The main thing is to log over the land so as to make sure of a natural new growth.

To carry out suggestions similar to these would, of course, require more or less State machinery, to which some objection may exist. It would mean, however, but a slight enlargement of the present efficient State Forest Service. In order to accomplish anything of substantial and permanent good the State must, sooner or later, play its full part and take its full responsibility.

And one thing more. Whatever schemes are worked out for the general improvement of forest conditions in California should be planned, by all means, in co-operation with the timber interests. With their help and advice everything may be accomplished; without their co-operation little or nothing will result. The timber interests are fully awake to the fact that better forest conditions are bound to come, sooner or later, and they are ready to do their part for the common good. It remains, then, for the State and all the other great interests involved to do their part. The whole question seems to resolve itself into a problem of how the timber owner and the people of California may best co-operate to bring about an immediate and efficient system of protection against fire, and how provision may be made to induce private owners to cut their timber and protect their lands with a view to keeping trees growing.

It seems hardly necessary to emphasize the vital importance of forest lands to the agricultural interests. This is a matter which is felt and thoroughly understood in California. Every drop of water is extremely valuable and a steady flow throughout the season is absolutely necessary for the successful growing of crops. On treeless lands where trees will grow a forest growth should be established as soon as possible; and in conjunction with this work the vast areas of dense chaparral, which in many cases are just as valuable for protection purposes as trees themselves, should be closely guarded from destruction by fire. This means hard work and heavy expense in the construction of trails, fire lanes and telephone lines, and it means, too, the building up of a trained force to fight out this problem on the ground. The people are fully awake to the gravity of the situation and are enthusiastic in their co-operation with the national government. What is needed more than anything else, however, is some definite and workable plan for the co-operative protection and conservative management of private and corporate mountain lands. When this is brought about, conservation of California's forest resources will be assured. Until this is brought about, the ultimate result will remain in doubt. The national government is doing what it can with the means at its disposal, but the final responsibility rests squarely with the State of California.

F. D. Cornell of Los Angeles county, of the Forestry Society of California, spoke on "Eucalyptus Planting in California." He showed that eucalyptus culture was a matter not only of State but of National importance, because of the menace of timber exhaustion. He paid high compliment to the Forestry Service of the Government, and told of its development during the past few years. In speaking of eucalyptus culture he said it was an industry that was sure to be recognized and developed, and divided the growing of eucalyptus into "commercial" and "timber" eucalyptus. After giving a careful resume of the historical and scientific facts relating to eucalyptus, he gave comparisons with various other woods, showing its adaptability for many uses now given over entirely to certain defined species of timber. He called attention to the need of Forestry Service studies where the people could be shown the results of definite work, and defined several methods

of gaining co-operation between the people and the Government.

O. H. Miller, secretary of the Sacramento Valley Development Association, had for his theme, "California's River Problem," and handled it in a thorough manner, going into interesting detail showing the needs of the rivers of the State. He showed the enormous land values at stake and the vast possibilities that were promised in the extensive plans necessary to proper conservation of the rivers and adjacent properties. In conclusion he said:

"What better result could this meeting accomplish than to see that a way is provided for the carrying out of this great Sacramento Valley project—irrigation, reclamation and navigation—all with one mighty effort; a project which, when completed, will forever stand as a monument to what man may do toward the conservation of the natural resources of this great country?"

G. B. Lull, State Forester, addressed the meeting on "Forest Tree Planting in California," and said in part:

"Tree planting has been carried on in California since very early time, but until recently there has been little forest tree planting. Trees, hitherto, have been set out mainly for the purpose of securing protection from the sun and wind, or for ornament, and the production of wood has been only incidental. The tremendous interest which has been aroused lately in forest tree planting is due to the mere general understanding of the growth and uses of various species of eucalyptus, together with an assurance of a market for the material.

"The area within which eucalyptus may be successfully grown is limited first by temperature conditions and, within this range, by moisture conditions. The various species differ in their power of enduring cold, and in their ability to withstand drought, and unless account is taken of their requirements planting can only result in failure. The State Forester examines tracts on request and makes reports and recommendations at the expense of the applicant."

W. W. Mackie, Soil Expert of the United States Department of Agriculture, in speaking on the topic, "The Conservation of California's Lands," said in part:

"Conservation as applied to California soils consists not only of soil conservation, but the development of the soil which is either non-productive or has not yet been made to produce its best yields. To conserve the fertility or productivity of California soils the following methods will have to be employed: Rotation of crops, change of crops, improved cultivation, irrigation, drainage and fertilization. To develop soils which have never been devoted to agriculture such factors as irrigation, drainage, flood protection, introduction of new crops and improved methods of culture will be found necessary. In conclusion some effects of markets, transportation and quality of the population on the conservation and development of the soil resources will have to be known and applied."

Dr. George C. Pardee, former Governor of California, and California member of the National Conservation Commission, spoke in part as follows:

"A year ago last May there was held in the city of Washington a meeting that those who attended believed was of the utmost importance. It was composed of the Governors of the forty-five States of the country, three advisory members from each State, and certain other gentlemen connected with the State governments or prominent in some phase of the conservation problem. Out of that meeting arose the appointment by the then President of the United States, of the National Conservation Commission, and under the direction of the president of that Commission, it is my pleasure to congratulate this body on the hearty activity that it has assumed in the consideration of this problem, and to express the hope that this body will lend its assistance and its encouragement to the work the National Conservation Commission is doing."

The speaker told of the enormous ravages that had been made upon the resources of the country in the burning and cutting of timber, averring that within the life of perhaps some of those present the magnificent redwood forests of California would have been totally destroyed, and in their place nothing left. He made the point that though in the past the forests of California had been regarded as inexhaustible and even though in the aggregate they had been but little affected so far, it was necessary to learn the lesson of conservation. He showed the effect of denudation of forests in particular localities, citing the instances of the country tributary to the Mad and the Eel rivers in Humboldt county, which streams, owing to the deforestation, were raging torrents in winter and spring, destroying property and causing irreparable damage.

"For such work," he continued, "the National Conservation Commission was appointed by President Roosevelt, and this was one of the greatest works that that great man ever did. The Commission was appointed to take stock of the assets of the United States and to lay out a plan whereby those national resources could be preserved and conserved. Our iron, coal, gold, silver, natural oil, etc., are in the earth only in limited quantities; they must eventually be used up, but the forests can be conserved even unto the end of time."

Dr. Pardee traced the steps taken at other times and in other nations to conserve and preserve natural resources, and he cited the case of the State of Maine, whose supreme court had declared that the owners of forests have no right to cut one foot of timber if by doing so the property below, adjacent to a stream, may be injured by such action which may cause the stream to rise and overflow.

George W. Pierce of Yolo county, Chairman of the Committee on United Pacific States, presented the following report:

"Through the California Promotion Committee the commercial organizations of California have been brought into effective co-operation, resulting in great good to the State as a whole, and exemplifying the value of teamwork in State building. Through this co-operation California has not only received wide advertisement, but her many industrial and commercial advantages have received attention in all parts of the civilized world. Her wants, from a governmental standpoint, have been given more attention than could possibly have resulted from the individual

efforts of the local organizations. This effective co-operative work should be carried to a broader sphere of usefulness by its enlargement to cover all the States of the Pacific Slope. This entire region has common interests, financial, commercial and industrial, and it is separated by natural obstacles from the rest of the United States, and differ in many material ways from the rest of the States of the Union. Their needs demand distinctive treatment. Specialization is required in their development. Organized effort is required to make this generally known.

"In order to bring about a concert of action on the part of the seven Pacific States, some general plan whereby the Pacific Slope region may be brought into closer relationship is essential. Such an organization should have its central idea formed around some such plan as has been so successfully followed by the California Promotion Committee in unifying the interests of California. To this end it is suggested that steps be taken by the California Promotion Committee to induce the formation of State Central organizations in Oregon, Washington, Idaho, Utah, Nevada and Arizona, or in such of them as have not already formed such central organizations.

"By means of a campaign of education, carried on through the Press and organizations already established, induce the people, as generally as possible, of all the localities of each of the above named States, to form local organizations, having for their object the upbuilding of each individual locality. Make this organization the unit of working force. Use it in combination as a foundation upon which to build a thoroughly developed State. Following the organization of these local bodies an affiliation should be effected with a central organization whose energies should be devoted to harmonious work looking to the upbuilding of the entire State.

"The seven State Central Organizations, as outlined, will then be in position to reflect the desires of every locality, in their respective States, thus arriving at a definite idea of what is required, either politically, commercially or industrially by the State as a whole. With this knowledge of the needs of the various States concentrated into seven organizations a United Pacific States Central organization should be formed with one representative from each of the seven State Central organizations. This United Pacific States central body should meet and decide upon all matter requiring concerted action, and then pledge the entire strength of all the local organizations of each of the seven States to assist in carrying out the conclusions reached. Such co-operation would enlist the active assistance of every United States Senator and every Congressman from the Pacific Slope. Every matter in which Federal aid is desired would be decided upon by the United Pacific States central body, thus giving any request, from any part of this section, a powerful backing in Washington, not only in Congress but in the departments as well.

"The benefits certain to accrue from the co-operation outlined are obvious. These would be constantly increased as the strength and importance of the central organization became apparent. Benefits arising from interchange of commodities, and the broadening of commercial relations would soon be realized, while the growth of the entire region would become a matter of common interest and general solicitude, as all parts became more interdependent and mutually helpful."

REPORT OF COMMITTEE ON GOOD ROADS LEGISLATION

The following report was submitted by the Committee on Good Roads Legislation, appointed at the meeting held at Los Angeles last November. The Committee is composed of H. A. van C. Torchiana, Santa Cruz, chairman; J. M. Eddy, Stockton; Samuel G. Buckbee, San Francisco; W. E. Gerber, Sacramento, and F. W. Blanchard, Los Angeles.

"To the Counties Committee of the California Promotion Committee:

"The Legislative Committee on Good Roads begs leave to submit the following report and recommendations:

"The most important legislative action relating to good roads in California, passed by the State Legislature at its recent session, was Assembly Bill No. 900, authorizing the construction, acquisition and maintenance and control of a system of State highways, and the expenditure of \$18,000,000 therefor. This is to be ratified by the people at the next general election, authorizing the State to issue bonds for the purpose of carrying out the provisions of the act. This will mean a system of roads which will cover the State and unite with County roads, and will place California in the forefront of States noted for good highways.

"Other bills of minor importance, such as Assembly Bill No. 901, Senate Bills Nos 7, 61, 128, 215, 242, 322, 332, 355, cover specified short roads to be built by the State in various parts of the State.

"All these bills are progressive steps in the plan to have a splendid system of highways in California, and all of them are commended.

"In addition to this legislative action the California Promotion Committee has prepared and circulated for signatures a petition to the Secretary of the Interior asking that automobiles be permitted to use the roads in Yosemite Park, under proper and suitable regulations. This petition is in the hands of the secretary of this meeting, and we recommend that it be generally signed by representatives of the organizations here assembled and be endorsed by this meeting."

The special interest of the report of the Committee on Highway Tree Planting, appointed at the Los Angeles meeting, as presented by Prof. Willis L. Jepsen, of the University of California, chairman of the Committee, lies in the selection of roads on which to initiate the plan of State-wide planting of highways. Two highways are designated as main axes for tree planting, the work to be gradually extended to branch roads and connected up with subsidiary axes in various parts of the State. The two main roads are El Camino Real, from Los Angeles to San Francisco, and the second the main highway along the east side of the Sacramento and San Joaquin valleys from Redding to Bakersfield, and connecting the most important cities of that region, threading a rich agricultural area and with direct highways to the towns of the gold and timber belt of the Sierra Nevada.

Planting should be done under the provisions of a recently enacted law by which boards of supervisors

are empowered to appoint a County Board of Forestry of five persons, and provide appropriations therefor. The County Board of Forestry appoints a County Forester, whose duties are especially concerned in highway trees, and whose term of office is at the pleasure of the Board. Failing favorable action of a Board of Supervisors, Improvement Clubs are expected to make beginnings on the plan in the way of planting to serve as model highways designed to have educational effect on the community.

The plan as a whole is expected to appeal to the imaginations of the people of California, since it will, when carried out, give us a system of highways the like of which exists in no other country on so great a scale.

At the conclusion of the meeting the following resolutions were offered and unanimously adopted:

Resolved, That this gathering strongly endorses the plan proposed by the National Rivers and Harbors Congress for the issuance of Government bonds in the sum of $500,000,000 for the improvement of the navigable rivers of the United States, believing said plan to be the most feasible yet proposed for securing much needed improvement of the interior waterways of our country, and we request our Senators and Representatives in Congress to use every legitimate means to bring about such a bond issue.

Resolved, That we heartily endorse the work of the United States Weather Bureau, and cordially recognize its services, which have been of inestimable value to the people of the State of California.

Resolved, That this Counties Committee of the California Promotion Committee cordially approves the development and carrying on of the policy of conserving the naturaly resources of the country, particularly its various mineral resources and the fertility of the soil, and commends the excellent work that has recently been done in that direction, believing that the end should be kept strictly in view that all such developments, in common with the other resources of the country, are for the advantage and benefit of the people residing in the districts where such resources exist, and are developed, and that such developments should be made with the end in view that such resources and the products of the same should be available to the people at the least possible cost and as widely distributed and enjoyed as the natural conditions would permit.

WHEREAS, The storage of water by companies engaged in the development of electric power, where such storage is upon the tributaries of the principal streams of the State, tends in a large degree to withhold the flood waters of such streams, and therefore reclaims and prevents the overflow of large districts of land needing reclamation, and the water so reserved and withheld is added later on to the natural flow of the streams in the dry seasons of the year, thus increasing the supply available for irrigation and other beneficial uses; therefore, be it

Resolved, That this Committee of the Counties Committee of the California Promotion Committee endorse the recent action upon the part of the United States Government making a reduction in the charges imposed upon the electric power where the same is developed by the use of such stored water, as we believe that all such beneficial enterprises should be encouraged to the end that the largest development of our natural resources may be obtained and the cost to the consumer reduced.

Resolved, That we heartily thank the United States Congress and our State Legislature for the Acts passed and the appropriations made to conserve, protect and foster the viticultural industry of this State and of the Nation.

Resolved: WHEREAS, The commercial culture of the eucalyptus trees in California has reached such large proportions, and is certain to assume so prominent a position in the future economy of the State and the Nation, and,

WHEREAS, There is a lack of absolute and official data on the subject of choice of species for given conditions and situations, and information concerning specific value of the many species, and their comparative values for specific and special purposes as regards the California-grown timbers; now, therefore, be it

Resolved, That the Forest Service of the National Government be asked to, at the earliest possible moment, institute most comprehensive tests and experiments in order that this official data may be placed at the service of the State, and be it further

Resolved, That it be requested that such investigations and tests be broadly commercial in their bearing, rather than technical, and that the results of such tests be published as rapidly as obtainable.

Resolved, That the Counties Committee approves of the appointment of the National Conservation Commission and desires cordially to co-operate in its work.

Resolved, By the Counties Committee, that the report of the Committee on Tourist in California, Committee on Good Roads, the Committee on Highway Tree Planting, and the Committee on United Pacific States be adopted, and that the California Promotion Committee be requested to carry out these several reports. Be it further

Resolved, That the Committee shall receive the thanks of this meeting and be discharged.

WHEREAS, Through the courtesy of the management of the Hotel Del Monte, this eleventh meeting of the Counties Committee of the California Promotion Committee has been greatly facilitated, and the delegates have been given most delightful surroundings, and

WHEREAS, Invitations have been received from the Chamber of Commerce of Monterey and the Board of Trade of Pacific Grove, to participate in certain entertainment, and

WHEREAS, This entertainment will follow the business meeting of the Counties Committee, consequently be too late to allow of this formal action, be it

Resolved, By the Counties Committee of the California Promotion Committee in Eleventh Semi-Annual meeting assembled, that the thanks of the organization be, and are hereby, tendered to the management of he Hotel Del Monte and to the Chamber of Commerce of Monterey, and the Board of Trade of Pacific Grove for these courtesies, and be it further

Resolved, That the secretary be instructed to so notify the management of the Hotel Del Monte, and the Chamber of Commerce of Monterey and the Board of Trade of Pacific Grove, and also give copies of these resolutions to the Press of the State with the request that they be given full publicity.

RESOLUTION OF THANKS TO THE PRESS.

WHEREAS, The Press of California, together with the Associated Press and United Press Associations, have been constant and faithful workers in the cause of upbuilding California, and

WHEREAS, The unselfish and persistent good work of this mighty force in civilization should be fittingly recognized on all occasions, be it

Resolved, By the Counties Committee of the California Promotion Committee, in Eleventh Semi-Annual meeting convened, that the heartfelt thanks not only of this Committee but of every Californian, in whatever walk of life he may be, is due to the Press and the Press Associations. Be it further

Resolved, That in acknowledgment of that due, the Counties Committee of the California Promotion Committee hereby extends to the Press of California and the Press Associations, its thanks and appreciation, on behalf of the two hundred affiliated organizations, representing every county in the State, and be it further

Resolved, That copies of this resolution be sent to the Press with the request that it be given publicity.

JOURNAL OF ELECTRICITY
POWER AND GAS

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PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

The resolution adopted by the Counties Committee of the California Promotion Committee at the semi-annual session held at Del Monte on Saturday last, and as printed in another column of the Journal, commendatory of the action of the government in lessening the charge to power companies for uses of the forest reserves of the government, while admirable of itself, does not go far enough.

Conservation Vital to Power Companies

In appreciation of the services rendered by the power companies indirectly to the government in its schemes of reclamation and irrigation and in the conservation of the forests, and directly to the people of the State of California, who are immeasurably benefited by the policies of the power companies, it must be remembered that the pioneers of hydro-electric transmission and natural conservation of the flood waters have been the power companies of this State.

Taking advantage of the earlier installations of reservoirs, ditches and flumes built by the hardy pioneers in mining, the power companies have been enabled to do more in the way of conservation than has as yet been accomplished by the government, and in the natural trend of the increase of its business, will, in their own protection, do still greater things.

The reforestation of the watersheds of California, denuded by the demand for timber, is as much to the interest of the power companies as it is to the people in the valleys, and the larger the reservoirs are built, and the more water impounded during the run-off of the winter months by the power companies for the purpose of establishing a high load factor at their plants, is of inestimable benefit to those living contiguous to the rivers of California by the prevention, through conservation of the wasteful floods in winter, and by the added quantity of flow to the rivers during the dry season, when the reservoirs of the power companies are drawn upon for power purposes.

The policy of the government toward the hydro-electric companies of the State should be of the most liberal character, and if a liberal policy is employed, it will be found that the power companies, in self-interest, will act in greater harmony with the government in all of the purposes towards which conservation is the factor.

The report of Messrs. Cory and Hunt submitted to the Board of Supervisors of the City and County of San Francisco with reference to the complaints of consumers of the gas companies supplying the city, and published in this issue of the Journal, is the most fitting reply to the unfair, prejudiced and unwarranted attacks made upon those companies in the wild hysteria of present attitude of the daily papers towards all public service corporations.

Unjust Criticism

It is pleasing to note that the verdict rendered by Messrs. Hunt and Cory entirely exonerates the gas companies from any of the many crimes charged against them, both by press and unreasonable consumers, and it is also a matter of congratulation, as indicated by this report, that the quality of gas, both in candle power and its high efficiency in heat units, furnished the people of the city and county of San

Francisco, is superior to that furnished anywhere in the United States, which is a true indication of the fairness of the lighting corporations towards the public.

In the development of the Welsbach burner and of gas appliances for heat, the necessity for a large number of B. T. U.'s has been made imperative, and the changes of manufacture of gas in the State of California, due to cheap oil, has made this possible.

In England a 14 c. p. gas of 450 B. T. U.'s is deemed an excellent quality of gas to be delivered by the company, and in the Eastern States, as a rule, the B. T. U.'s do not exceed 500 and the c. p. 18.

It is but reasonable to suppose that the hysterical attacks made by the daily press upon the company in other matters than that of the quality of its gas, are about as near correct as their charges have been proven to be in these particular instances.

All of this leads up to the absolute necessity for some amendment of the present laws, and particularly of the Constitution of this State, which will permit of the placing of public service corporations within the control of a Board of Commission, similar to that existing in Massachusetts, Wisconsin and other States, so that full justice may be done by impartial investigations, both to the companies operating and to the consumers, to the end that the daily bickerings between public and corporations may, by judicial enactment, be removed from the domain of prejudice, and put upon that high plane which will give to the companies a just return upon capital actually and honestly invested and to the consumer a low rate consistent therewith and a character of service that cannot be attacked.

NEW CATALOGUES.

The steady growth of the Weber line of electrical specialties is demonstrated by Catalogue No. 2 covering this line issued under date of May 10th by Henry D. Sears, General Sales Agent, 131 State street, Boston, Mass.

It covers in detail their complete line and includes sockets, receptacles, both weatherproof and pendant, rosettes, fuse plugs, plug cut-outs, and a very complete line of wiring knobs and insulators. It is very conveniently arranged and of a handy size for the pocket or desk pigeon hole. The price list which accompanies it is uniform with the catalogue and is so designed that it can be readily inserted in the back.

Typographically it is an excellent and artistic piece of work and is in keeping with the Weber line of specialties.

The merits of tantalum lamps for train lighting are emphasized in a recent pamphlet issued by the General Electric Company, Schenectady, N. Y.

In point of efficiency, it is there stated, the tantalum lamp is much superior to the ordinary carbon filament lamp, consuming but 2 watts per candle of light against 3 to 3½ watts for the carbon filament lamp. Its average life is materially longer than that of the ordinary carbon train lighting lamp, and moreover its light is of a superior brilliancy and illuminating value. For example, the 35-watt carbon lamp gives 10 candlepower, whereas the 25-watt tantalum gives 12½ candlepower, or the tantalum lamp consumes 30 per cent less current but gives 25 per cent more light than the carbon filament lamp, and its light is of more attractive and agreeable quality.

The tantalum lamp can be substituted for carbon lamps without any changes in the voltage, wiring or sockets. It is made in general in the same types and voltages as the present carbon lamps, so that its trial is a simple proposition.

PERSONALS.

W. F. Murphy, General Manager of the Idaho Consolidated Power Company, has returned to Pocatello, Idaho, after spending several weeks upon the Pacific Coast.

J. C. Kirkpatrick, president of the National Pole Company of Escanaba, Mich., and the American Cross Arm Company of Chicago, is expected in San Francisco during the coming week.

Mr. E. G. Dewald, manager of the Water Wheel Department of the Platt Iron Works of Dayton, Ohio, is in San Francisco in the course of a trip during which he will cover the entire Pacific Coast.

J. J. Foley, in charge of the Telephone Installation Department of the Western Electric Company on the Pacific Coast, has just returned from a trip of several weeks in the neighborhood of Butte, Montana.

Thomas G. Grier, Western agent for the American Circular Loom Company at Chicago has just returned from a six weeks' trip to Bermuda, Cuba and Porto Rico and reports a pleasant time and renewed health.

Kempster B. Miller of Chicago is making a short trip to California, where his firm of McMeen & Miller has extensive telephone work under way. Mr. Miller will combine both business and pleasure during his brief stay.

Chas. J. Thelan, for the past five years connected with the Brooks-Follis Electric Corporation of San Francisco, and Stephen E. Gamble, owner and manager of the Sebastopol Electric Light Company of Sebastopol, Cal., have organized the Eureka Electric Construction Company to engage in electrical construction work of every description at Eureka, Cal.

B. Elshoff, for twelve years assistant superintendent of the Allis-Chalmers-Bullock Company, of Cincinnati, and for the past two years superintendent of the electrical department of the Allis-Chalmers Company of Milwaukee, has recently severed his connection with the last named company. Mr. Elshoff may eventually accept a position with an eastern firm but for the present will remain in Milwaukee.

H. C. Rice, author, playwright, poet and, incidentally, vice-president of the General Incandescent Lamp Company of Cleveland, Ohio, is spending a few days in San Francisco. In addition to devoting the necessary amount of time to the above occupations, Mr. Rice finds opportunity to take a great deal of interest in running horses, of which he is a great admirer. The accompanying portrait shows him in riding costume and is from a snap-shot taken just after a short dash on his favorite running horse "Comet." Mr. Rice will spend two or three weeks on the Coast partly on pleasure and partly in the interest of the General Incandescent Lamp Company.

H. C. Rice.

O. W. Lillard of the San Francisco office of the Gould Storage Battery Company is in Los Angeles, where he will remain until the latter part of May superintending the installation of the storage battery plant of the Home Telephone Company there.

Richard T. Laffin has become associated with the Stone & Webster Management Association in connection with the Seattle Electric Company and other Puget Sound railway and lighting properties. Mr. Laffin was for many years connected with the Boston Elevated Railway, and was later general manager of the Worcester Consolidated Street Railway. He resigned from the latter position to become vice-president and general manager of the Manila Electric Railroad, and spent about four years in the Philippines in establishing and organizing the property, having only recently returned to this country.

Character and Quality of Gas Furnished to the City of San Francisco

We give below the joint report of A. M. Hunt and C. L. Cory, consulting engineers, on the character and quality of gas furnished to the city of San Francisco, with special reference to complaints against high bills during the months of December, 1908, and January and February, 1909.

San Francisco, April 9, 1909.

To the Committee on Artificial Lights, Board of Supervisors, City and County of San Francisco, California.

Gentlemen: At your request, we have made as full an investigation as possible into the character and quality of the gas supplied in the city of San Francisco, with especial reference to the complaints of high bills during the months of December, 1908, and January and February, 1909.

There being no records available for the months in question, except those of the companies supplying gas, we have been compelled to use their records, supplementing them with such investigations as we have been able to make ourselves during the past three weeks.

The results of our investigations have been negative so far as disclosing any general condition that could account for abnormal bills during the past winter, *except that the winter months are always those of maximum use of gas, and that the months of January and February were abnormal as regards the large amount of cloudy and cold weather.* It is also a fact that the San Francisco Gas & Electric Company have since July, 1908, been collecting a rate of $1.00 per thousand for gas, while for two years prior to that date, they had collected only 85c per thousand. The increase of rate amounts to about 17 2-3 per cent. The average increased use during the months above noted cannot be determined, but that it was materially higher than for the same months of a normal winter is certain.

The time and facilities available made it impossible to test a sufficient number of meters (there being over 60,000 in use) to ascertain the average accuracy of all the meters in use.

Our method of procedure in reference to meter testing was as follows:

We received from various sources eighty-one complaints of high bills. Of these, twenty-four were selected, after investigation of the data, and the meters were taken out and tested by us, using a standard meter prover.

Seven of the meters were found correct within one per cent; twelve were fast, the average being 2.87 per cent; and five were slow, the average being 4.2 per cent. The maximum percentage fast was six per cent, and the maximum percentage slow was seven per cent.

The facts disclosed do not show a condition of affairs as regards the meters which can be considered as serious.

The most flagrant case, so far as appearances go, brought to our notice was one in which the bill from January 12th to February 12th, 1909, was given as $1.70, and from February 11th to February 26th, 1909, as $11.85. On this latter date, the customer discontinued his service with the company which had been supplying him and took gas from the other company.

An examination and analysis of his bills for the periods preceding and following the dates above given are instructive, as noted below.

NOTE BY SAN FRANCISCO GAS & ELECTRIC COMPANY.

From the accompanying report of two able and disinterested experts it is demonstrated that the character of gas supplied by the San Francisco Gas & Electric Company is better than the average standard of gas furnished elsewhere in the United States, both as to its candle power and heat-giving qualities. It is also apparent that the very vicious criticism of the company was totally undeserved and unwarranted.

The aim of the company is to give good service, and it invites at all times honest criticism and complaints of consumers, and will endeavor to right any and all wrongs, its motto being:

"Solve all doubts in favor of the consumer."

JOHN A. BRITTON, President.

STATEMENT OF GAS ACCOUNT.

Meter set March 12, 1908, at zero.

	Date.	Cu. Ft. used.		No. of days.		Rate per 1000.	Cu. Ft. per day.		Charge.
	Apr. 13th.	20,200		32		75c	631		$15.15
	May 13th	20,200		30		75c	670		15.15
Changed	June 11th.	32,400		29		70c	1119		22.70
6 19. Test	July 14th.	18,800		33		80c	570		15.05
2% fast.	Aug. 14th.	10,400		31		80c	335		8.30
	Sept. 14th.	14,400		31		80c	464		11.50
	Oct. 14th.	10,800		30		80c	360		8.65
	Nov. 13th.	17,400		30		80c	580		13.90
	Dec. 11th.	25,200		28		75c	900		18.90
	Jan. 12th.	9,400		32		85c	294		8.00
Changed	Feb 11th.	2,000	16,800	30	45	85c	63	373	1.70
2 26. Test	Feb. 26th.	14,800		15		80c	987		11.85
5% slow.	Changed to other company.								
	Meter set February 24, 1909, at zero.								
	Mar 9th.	10,800		13		75c	830		8.10
	Mar. 24th.	12,600		15		75c	840		9.45

The quality of gas supplied by both the San Francisco Gas & Electric Company and the Metropolitan Light & Power Company is excellent.

On March 23rd, 1909, the gas being delivered into the mains by the S. F. G. & E. Co. had a candle power of 23.6 with a gross heat value of 710 British Thermal Units. The records of the company for the past year indicate that this same high standard has been maintained during that period.

The gas of the Metropolitan Light & Power Co., on April 6, 1909, had a candle power of 18.8 and a gross heat value of 651 British Thermal Units. From the company's records the average candle power for the month of December, 1908, was 19.13; for the month of Janary, 1909, 19.58. The average gross heat value (also from the company's records) during these months was, December, 1908, 652 British Thermal Units; January, 1909, 690 British Thermal Units.

It can be definitely stated that the gas supplied by both these companies is of as high or higher quality as regards heat value than any artificial gas supplied to any other community of which we have been able to find records.

The analyses of the two gases obtained by us are appended. The question has been raised as to the amount of carbon monoxide contained in the gas supplied in San Francisco. The analyses obtained by us show that the gas sent out by the S. F. G. & E. Co. contained 12.6 per cent carbon monoxide on March 23rd, 1909, and that of the Metropolitan Co. 4 per cent on April 6th, 1909. In practically all the large communities of this country, except on the Pacific Coast, the gas is made by what is known as the carburetted water gas process, and usually contains about 26 per cent of carbon monoxide. *It will be seen that both the gases supplied in San Francisco contain only a fraction as much of this component as exists in the bulk of the gas which is distributed in Eastern communities.* The relatively larger amount contained in the gas of the S. F. G. & E. Co. as compared with that of the Metropolitan Co. is due to the fact that the former company

manufactures both oil gas and carburetted water gas, which are mixed before being distributed.

An examination of the analyses shows [illegible] had been admixed with air. It is not generally [illegible] admixture of air with an illuminating gas [illegible] candle power very rapidly. To illustrate this we had candle power tests made on gas containing various percentages of air. Results are given in the table below.

% of air mixed with the gas	Loss of candle power in % of that of unmixed gas
1%	8%
3%	16%
5%	26.2%
8%	33.8%
12%	58.7%
15%	71.1%

It is readily seen that any attempt to dilute the gas [illegible] to increase its volume by any appreciable amount [illegible] panied by such a serious loss of candle power as to be [illegible] at once.

It has been claimed that a gas company can, by increasing pressure on its mains, force gas through the meters into the house pipes, and that this gas will, when the pressure is again lowered, pass back into the mains, the net result being that the meter records gas that has not been used. To ascertain if this be possible, we connected the outlet of a new and tested meter to a tank having a volume equal to the entire piping system of an average house. The inlet side of the meter was connected to a small tank containing gas, in which the pressure could be varied from a low pressure (1½ inches of water) to the maximum pressure on the mains. After carefully noting the position of the pointer of the test dial of the meter, the pressure was varied between the extreme limits ninety [illegible] times. This would represent the probable number of fluctuations of pressure in the mean during the period of a month, arising from the three peaks per day caused by the heavy demand for gas for cooking. *At the conclusion of the test, the pointer [illegible] The test was a severe one [illegible] [illegible]pletely.*

A test was made to determine the effect of the change of pressure of gas upon the economy with which it is used in an ordinary gas range for general cooking purposes. [illegible] test the pressure of the gas was artificially varied through a wide range, from a minimum of .5 inch to 6.1 inches of water, or a total variation of 5.6 inches. The adjustment of the burner was so made as to give what was considered the proper [illegible] flame under a four inch pressure, and [illegible] the tests were made with no change whatsoever being made in [illegible] [illegible] in the burner.

In order to measure the amount of gas required to do an equal amount of heating under the different pressures, one [illegible] of water was in each case heated in an ordinary [illegible] tea kettle, and enough gas was burned to increase the temperature of the water 100 degrees Fahr., the initial temperature of the water in each case being about 60 degrees Fahr.

During the test the amount of gas used was measured by both a new meter which had previously been tested [illegible] correct, and by the prover, which is ordinarily used [illegible] the accuracy of the meters.

The complete results of these tests are given below.

Pressure of Gas	Cu. Ft. of Gas	Time Required
0.5 inch	3.45	19 min. 40 sec.
2.0 inches	3.80	9 " 32 "
4.0 "	4.35	8 " 4.5 "
6.1 "	4.24	5 " 52 "

An examination of the results of the test shows conclusively that while the length of time required to heat the given quantity of water was much greater for the lower pressures, yet the amount of gas consumed was less at the lower pressure, *so that [illegible] Dec[illegible] could not have been due to the [illegible] pressure.*

In this connection it should be noted that the maximum fluctuations of pressure found by us, after taking simultaneously [illegible] four records at five different places, was in the Richmond district, on Twenty-fifth avenue, north of Lake street, which on April 1st showed a fluctuation of 6.4 inches.

We earnestly recommend that the city establish a laboratory and equip it with instruments so that the city gas inspector can make regular tests. Such a laboratory should be located at a point where service pipes may be run in from the mains of both companies supplying gas. It should be equipped with the following instruments:

One (1) standard 5-ft. meter prover, complete.
One (1) 100-inch standard bar photometer.
One (1) candle balance.
One (1) Pentane lamp, 10 candle power.
One (1) Junker calorimeter, for gas.
One (1) Hempel gas analysis apparatus.
One (1) dozen sample tubes for gas.

The necessary supply of glassware, re-agents, tubes, etc. In addition to the above there should be provided at least four seven-day pressure recording gauges and two 24-hour pressure recording gauges.

The above equipment will cost installed not to exceed two thousand dollars ($2000.00).

The gas inspector should be required to make analyses, candle power and heat value determinations of the gas at least [illegible] times each week, keeping permanent record of his results. The four seven-day pressure gauges should be installed at [illegible] selected points and continuous records of the pressure [illegible] at these points should be kept on file. One of the 24-hour gauges should be installed in the laboratory, the other being available for use at any point from which complaints of [illegible] fluctuating pressure are received. The total lack of such data as is noted above has made it impossible for us to [illegible] the conditions obtaining during the past winter, when gas consumption was heavy and complaints of high gas bills were most frequent.

In conclusion we can only report that we have discovered no facts which indicate that the gas companies have during the past winter done anything which would increase the amount of gas used by consumers. The gas at present supplied is undeniably of high quality, and the records of the companies substantiate their claim that [illegible] the case during last December, January and February.

[illegible] meter tests qualify the statement that the meters in use are of good, reliable make, and record correctly within the [illegible] limits of accuracy.

Undoubtedly there have been, and will always be, sporadic cases where complaints are just, and gas meters will also be found which record incorrectly.

The San Francisco Gas & Electric Company and the Metropolitan Light & Power Company have shown us every courtesy and extended [illegible] facilities asked for.

Respectfully submitted,

A. M. HUNT.
C. L. CORY.

[illegible] Co. March 23, 1909.

Heavy hydrocarbon	10%
Marsh gas	32%
Hydrogen	36.1%
Carbonic oxide	12.6%
Carbonic acid gas	3.4%
Oxygen	0.2%
Nitrogen	5.7%
	100.0%

Candle power—23.6. Heat value—710 B. T. U.

Analysis of sample of gas taken from S. F. G. & E. Co.'s mains at 3245 Twenty-first street

March 31st, 1909

Heavy hydrocarbons	8.4%
Marsh gas	32.5%
Hydrogen	39.0%
Carbonic oxide	10.2%
Carbonic acid gas	3.2%
Oxygen	0.2%
Nitrogen	6.5%
	100.0%

Heat value—686 B. T. U.

Analysis of samples of gas taken from the mains of the S. F. G. & E. Co. at 154 Lake street on

March 31st, 1909

Heavy hydrocarbons	8.6%
Marsh gas	32.1%
Hydrogen	38.5%
Carbonic oxide	11.2%
Carbonic acid gas	3.0%
Oxygen	0.2%
Nitrogen	6.4%
	100.0%

Heat value—687 B. T. U.

Analysis of gas of Metropolitan Light & Power Co.

April 6th, 1909

Benzene	1.2%
Acetylene and other illuminants	5.6%
Carbon monoxide	4.0%
Methane	35.2%
Hydrogen	40.9%
Carbon dioxide	2.2%
Oxygen	1.5%
Nitrogen	9.4%
	100.0%

Candle power—18.8. Heat value—650.8 B. T. U.

STANDARD OF GAS ESTABLISHED.

Under an amendment to the Gas Rate Ordinance for next year, recently adopted by the Board of Supervisors of San Francisco, gas must be of 19 candle power and have not less than 600 British thermal heat units. Failure to maintain this standard will render officials of the local gas companies guilty of a misdemeanor and places them in position where they must defend themselves against action which may be brought by any consumer.

BELGIAN STEEL WORKS ADOPT ELECTRIC FURNACE.

Consul H. Albert Johnson reports that the important Belgian steel works of the Cockerill Company, in Liege, have just started an electric furnace, which he describes:

This furnace is built on the Girod system, with one electrode, and has a charging capacity of from two to three tons of steel. The dynamos furnishing the necessary electric current—an alternating current of 50 volts—are operated by gas motors, utilizing the gas from the blast furnaces. The electric furnace is placed in a specially constructed building in close proximity to the steel converters, with which it is connected by a traveling crane, with a truck arrangement for transporting the ladles to the converters, which, when filled with molten metal, place it directly in the electric furnace.

NATIONAL ASSOCIATION STATIONARY ENGINEERS.

San Francisco, Cal., May 6, 1909.

Cal. No. 3, N. A. S. E. held a regular session on May 5th and among other matters of interest to the engineers which were transacted was that of the election of delegates and alternates to the State Convention to be held in San Francisco in June. They are as follows:

Delegates: H. D. Saville, Wm. P. Millner, Chas. Knights, J. B. Williams.

Alternates: David Thomas, C. E. Van Meter, P. J. De Lasaux, W. N. Munro.

Brother H. D. Saville, President of the State Association, accompanied by President Millner of Cal. No. 3, Mr. Chas. L. Turner, and a number of other engineers, visited California Association No. 8 of Stockton during the past week, and the visitors were right royally received by the Stockton contingent. This visit was made in pursuance of President Saville's settled policy, to foster the spirit of fraternity, sociability and mutual education in all things which pertain to engineering in which is embodied the fundamental principles of the National Association of Stationary Engineers.

Yours fraternally,

DAVID THOMAS, Recording Secretary.

San Francisco, No. 1, N. A. S. E., has elected the following named members as delegates and alternates to attend the State Convention to be held in this city next June: Delegates—John W. Maher, Louis Honigbaum, Conrad Witzel, Chas. Bankey, A. T. Peery, John T. Stewart, Theodore Heins. Alternates—Geo. James, W. H. Kearney, David Hanley, Dan Murphy, Claude Bregard, F. H. Cherry, Fred E. Kuhl.

At the meeting of May 1st, President Maher interested the members with a brief talk, explaining the starting mechanisms of different kind of electric motors—alternating and direct current. The subject was very interestingly handled, although being entirely impromptu, in response to a question by one of the members.

The headquarters of the employment committee has been removed from the store of the Squires & Byrnes Company, on Stewart street, to the engine room of the Grant building, on Market street, and D. W. McCarthy, chief engineer at the Grant building has been appointed chairman of the employment committee. A telephone has been placed at the headquarters for the convenience of members and employers who wish to obtain engineers at short notice. The telephone number is Market 6714.

Owing to the expiration of the lease of the hall at 933 Market street and the desire of the landlord to convert the premises for other uses, the association is compelled to move its meeting place. A committee has been appointed to find suitable quarters and are meeting with some difficulty in finding a satisfactory hall for Thursday nights.

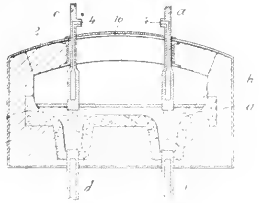
The death is announced of Mr. Ira Watts, National secretary-treasurer of the life and accident department N. A. S. E. Mr. Watts, who had been engaged in a consulting business at Spokane, Wash., had been identified with the National Association for many years and was well known throughout the country to the engineering fraternity. He was formerly chief engineer of the Knickerbocker building, New York.

A. T. PEERY, Secretary.

Stockton No. 8, National Association Stationary Engineers, have elected the following members as delegates and alternates to attend the State Convention to be held in San Francisco: Delegates, G. C. Turner, William Griffith; alternates, J. E. Kelly, S. Bunch.

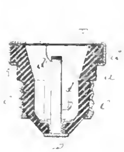
PATENTS

920,078. **Electrical Furnace.** Hans Nathusius, Friedenshutte, near Morgenroth, Germany. In an electric furnace, a hearth, a cover therefor provided with slots, electrodes



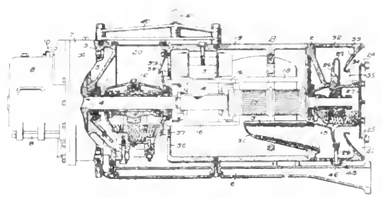
arranged to be guided by said slots, and additional electrodes to cause electric current to pass through and around material contained in the hearth.

920,005. **Plug-Fuse.** Harry U. Badeau and Frederick P. Poole, Bridgeport, Conn., assignors to The Bryant Electric Company, Bridgeport, Conn. A ventless fuse plug, having a cup-shaped insulating body with terminals and containing



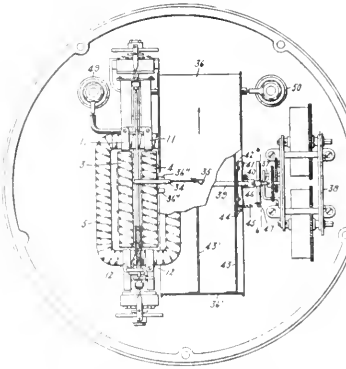
within it only a flat fuse strip, having at a point within the cap a reduced cross-section for the melting-point, in combination with an inclosing cover.

920,052. **Turbo-Generator.** Brace H. Hamilton and William E. Ver Planck, Lynn, Mass., assignors to General Electric Company. In combination, a dynamo-electric machine having poles, an armature and current collecting devices together with a cylindrical casing or frame inclosing the same, a cylindrical head for the casing, a nozzle projecting from the inner wall of the head into the casing which receives air from the interior of said head and has its discharge



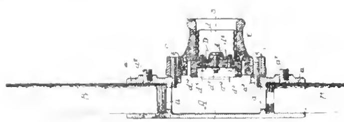
opening extending adjacent the armature and current collecting devices, and a baffling device intermediate the air inlet and the nozzle for preventing the entrance of foreign matter with the air to the interior of the machine comprising a cylindrical plate centrally located adjacent the outer edge of the head, another centrally located plate substantially parallel to the first, and a plate projecting inwardly from the outer edge of the periphery of the head into the space between the parallel plates and having a central opening of less diameter than the outer diameter of said plates.

920,084. **Recording Instrument.** William H. Pratt, Lynn, Mass., assignor to General Electric Company. In an electrical instrument, the combination with a movable coil



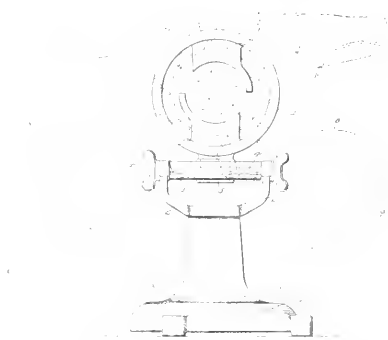
of stretched wire passed near its fixed or stationary ends through bearings on the body of the coil, means for supplying electrical current to the coil.

919,940. **Outlet-Fixture for Conduits.** Henry T. Paiste, Philadelphia, Pa. A fixture consisting of a hollow structure having an opening for the reception of a conduit, said opening being unthreaded within its outer portion but having at



its inner portion threads for the reception of the threaded end of a conduit, with means for holding a conduit in the unthreaded portion.

919,898. **Electric-Fan Support.** Evrah C. Lipps, Warren, Ohio, assignor to The Peerless Electric Company, Warren, Ohio. In combination, a support, a fixed yoke, a base plate,



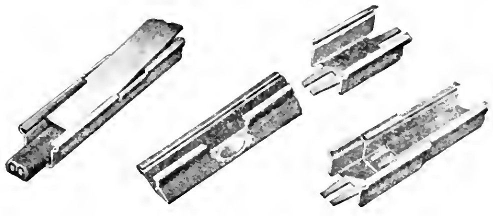
a motor rotatably mounted on said base plate so as to be capable of movement in a horizontal plane, and means connecting the base plate to the yoke so as to be capable of adjusting the motor in a vertical plane.

INDUSTRIAL

"LUTZ" METAL MOULDING

The American Circular Loom Company, Boston, Mass., is again marketing "Lutz" Metal Molding after rebuilding its plant at Kenilworth, N. J., where this product was made, and which was destroyed by fire.

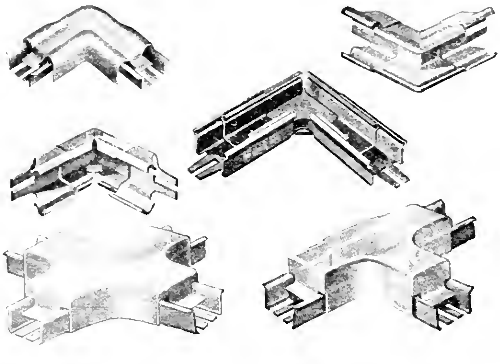
"Lutz" Metal Molding was designed, perfected and patented several years ago. It is approved by the Underwriters, has been used in a number of installations and provides, within a very small space, a complete and continuous raceway for electric wires with fittings for every detail of construction. It is easily installed with the minimum amount of labor.



"Lutz" Metal Molding is furnished in 10-foot lengths and of suitable dimensions to contain two wires or twin conductors which are "laid-in." It is made of Steel, electro-galvanized and consists of a Base in channel form with grooved exterior flanges into which, after the wires are "laid-in," the Flexible Capping slides easily; thus entirely closing the raceway and supporting and protecting the wires. Countersinks are provided at intervals in the Base to receive the necessary screws or nails for fastening it to walls or ceilings.

The exterior flanges can be readily opened at any point for the purpose of sliding in the Capping or removing it to make changes or additions without disturbing the Base or in any way jeopardizing the conductors.

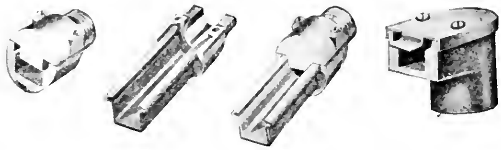
The several lengths of "Lutz" Metal Molding are rigidly and effectually Coupled or Bonded together by "Lutz" Couplings or Bonds with pronged ends which are bent to engage with slots cut in the Base.



"Lutz" Elbows, both Rigid and Adjustable have pronged ends to engage with slots cut in the Base. These are closed by special covers or by overlapping the ends of the Flexible Capping at the angle of the Elbow.

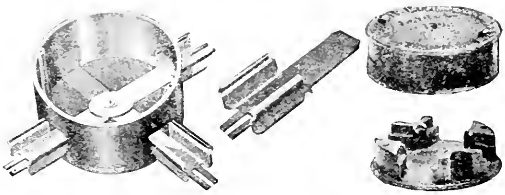
"Lutz" 3-Way and 4-Way Tees have pronged ends to engage with slots cut in the Base and covers which are held securely in place by lugs over which the Flexible Capping slides.

"Lutz" Adapters are for the purpose of connecting "Lutz" Circuits with Rigid Conduit installations and also with Panel Boards. They have recessed chambers to engage with the Base and lugs to preserve the Capping from contact with wiring connections.



"Lutz" Porcelain Rosettes, Receptacles and Switch Bases straddle and fit the Base. They are furnished with wiring connections and have lugs to preserve the Capping from contact with the connections.

"Lutz" Outlet Boxes are furnished with either special Outlet Bonds or recessed chambers to engage with the Base. Outlet Bushings are not necessary.



"Lutz" Fixture Straps straddle and fit the Base and are held in position by screws and lugs over which the Capping slides

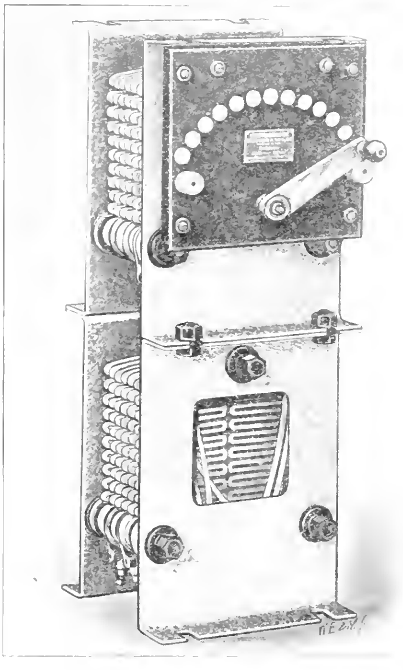
"Lutz" Toggles are for the purpose of fastening the Base to the fireproof walls or ceilings.

"Lutz" Metal Molding is for sale by all Jobbers in Electrical Supplies. Fully illustrated Booklets will be sent upon request by the American Circular Loom Company, Boston, Mass., or any of its branches.

BATTERY CHARGING RHEOSTATS FOR DIRECT CURRENT.

For use wherever a small storage battery is maintained as in public and private garages where only constant voltage direct current is available, a storage battery rheostat is now being sold by the Westinghouse Elec. & Mfg. Co. Some form of resistance must be employed since the voltage at the beginning of the charge is less than is required when the batteries are fully charged, and it is therefore necessary to reduce the voltage, usually by an adjustable series rheostat. The voltage applied to the battery should be raised gradually from the minimum value at the beginning to about 2.7 volts per cell at the end of the process.

The illustration shows a type "DB" battery charging rheostat for 40 to 44 cells which is capable of carrying 50 amperes on any position; other rheostats are supplied for the same current capacity to charge 10 to 14 cells from 110 to 120 volt circuit.



Westinghouse Battery Charging Rheostat.

To select a charging rheostat for a given service the circuit voltage, the minimum allowable battery voltage and the charging current in amperes must be known. The required rheostat resistance can then be computed as follows:

$$\text{Resistance of rheostat} = \frac{\text{Circuit Volts—Battery Volts}}{\text{No. Amperes Charging Current}}$$

The battery voltage is the product of the number of cells in series and the volts per cell. For example, to charge a battery which has 36 cells connected in series, at a maximum rate of $7\frac{1}{2}$ amperes from a 110 volt circuit, the minimum voltage or the initial charging voltage being 2 volts per cell the resistance in the rheostat would have to be as great as

$$\frac{110 - 36 \times 2}{7.5} = 5.07 \text{ ohms approximately}$$

and the standard rheostat with $5\frac{1}{2}$ ohms resistance would be required.

Although these rheostats are rated as for 110 to 120 volts it is possible to use them on higher voltages provided the resistance is great enough to keep the current within the maximum allowable amperage for the batteries, but of course the current capacity of the rheostat must not be exceeded.

These rheostats have a standard finish of black marine for the face plate, the resistance grids are coated with aluminum paint, and the supporting frames are galvanized making rusting impossible. The general appearance of the complete rheostat is such that it can be mounted near any switchboard without forming a displeasing contrast.

The resistance is of the grid type and is rigid, compact and substantial, insuring a long life if not abused. There are thirteen steps by which the resistance can be adjusted, giving ample opportunity for maintaining the current at the correct value. The entire construction is particularly suited for operation by persons unfamiliar with electrical appliances.

NEWS FROM THE ISTHMUS OF PANAMA.

Electrician Killed at Cristobal.—In a conflict between the Panama police and the employees of the Canal Zone, on May 11th, C. M. Abbott, an electrician in the power house at Cristobal was killed.

Oil as Fuel at Miraflores Power Plant.—At Miraflores the Mechanical Division is erecting a 225,000 gallon tank for the storage of oil for fuel in the electrical plant that will supply power for the construction of the locks at Pedro Miguel and Miraflores. This tank is four and one-half times the size of the water tank located on Ancon Hill. The riveting work will be done by pneumatic machinery, an air line having been run to the site for this purpose.

Electrical Current for Colon and Cristobal.—The electrical subdivision of the Mechanical Division is working on an electric light pole-line to connect Cristobal and Colon with the large power generating plant in process of erection at Gatun. This will be a permanent plant, and when in operation will permit of the discontinuance of the electrical generating plants now in Colon and Cristobal, as the Gatun plant will furnish, in addition to the current required there, all the current necessary for the use of the Isthmian Canal Commission and the Panama railroad in Colon and Cristobal.

New Power House.—Work on the power house was satisfactorily continued during the month. About 11,250 square feet of basement floor and 2,000 square feet of walls have been given a water-proof coat of tar and Period roofing paper. About 3000 square feet of floor was finished by masons, the boiler room section having been completed. During the month, all forms for the first floor were built and put in place. The erection of the superstructure was commenced, and 70 per cent of the framing completed. Posts for turbine room were set up, and two trusses put in place. The discharge culvert was completed during the month, and all masonry work completed excepting finishing the paving and construction of the water table around the building. All conduit has been placed in the boiler room floor and in one-half of the turbine room floor. Three base condensers have been set.

CORNING, CAL.—The Northern Electric Power Company is making arrangements to increase its supply of electrical energy in Corning and surrounding country from 2,000 to 6,000 horsepower. The increase is made to meet the demand for electricity for pumping purposes throughout the Maywood Colony. The company is rebuilding its old lines and erecting new transmission lines throughout the town.

TRADE NOTES.

The Western Electric Company is now employing in all about 17,000 persons.

The American Electric Heater Company, makers of electric heating appliances, have just moved into new quarters in Detroit, Mich., with improved equipment and much increased space.

The California Incandescent Lamp Company of San Francisco are arranging to move from their present location at 117 New Montgomery street, to 669 Mission street, in the new Roberts Building.

The Standard Eelectrical Works of San Francisco expect within the next week or ten days to occupy their new quarters in the Roberts Building, which is now being completed at 665-671 Mission street.

Advices from Tokio announce the amalgamation of the American General Electric Company, the Shibaura Engineering Works and the Tokio Electric Company. The American General Electric Company is a big shareholder of the Tokio Electric Company, which is now principally manufacturing electric lamps.

March sales this year of the Western Electric Company were at the rate of about $18,000,000 a year. Telephone sales continue to show a steady improvement not only to the Bell companies, but to outside telephone companies. The greatest ratio of increase in the company's sales has been for some time in the sales to the non lessee companies.

The Dean Electric Company of Elyria, Ohio, has just closed a contract at Atlantic, Iowa, for a Dean common battery multiple switchboard of two sections, providing exchange apparatus for 540 lines and 35 rural connections. This contract includes wire chief and chief operator's desks and complete terminal and power facilities. The apparatus is arranged for Dean Harmonic selective party line operation.

The Western Electric Company of San Francisco, Los Angeles and Seattle, reports that it is now ready to accept orders for Sunbeam Tungsten lamps in 220 volts and it is understood that immediate shipment can be made in this voltage in the 70 watt and 105 watt sizes. This will be welcome information to many of the high voltage plants which heretofore have been unable to use Tugsten Lamps without wiring them in series. A large demand for these lamps is anticipated.

The annual meeting of the National Electric Light Association will be held at Atlantic City, N. J., June 1, 2, 3 and 4. On the first two days there will be two sessions each day; on the last two days there will be parallel sessions devoted to commercial, technical and accounting subjects. The business headquarters, together with the meeting and exhibit halls, will be on Young's "Million Dollar Pier." The secretary's headquarters will be located near the entrance.

The Belden Manufacturing Company, Chicago, Ill., have been appointed special agents for the Hope Webbing Company of Providence, R. I. The company will have complete charge of the sales of electric tapes, webbings and sleeving for the Hope Webbing Company in Illinois, Wisconsin, Iowa, Minnesota, South Dakota, North Dakota and Montana, and will carry a large stock of these goods in their Chicago warehouse, from which immediate deliveries to the Western trade can be made.

The General Electric Company recently shipped three carloads of material to Seattle, Wash., as an exhibit in the Alaska-Yukon-Pacific Exposition. Almost every class of apparatus is included in the display, from heavy mining machinery and electric locomotives to the latest household appliances. The General Electric Company has furnished the equipment for the exposition buildings, which does not include generating machinery as the energy for the exposition is purchased from the local power company.

At the Alaska-Yukon-Pacific Exposition, to be held at Seattle, from June 1 to October 16, there will be special facilities for the exhibition of inventions of all kinds, not necessarily in manufactured shape. The details of this section are in the hands of Mr. Algar M. Wheeler, Manufacturers' Building, Seattle. A moderate fee, not more than $30, will be charged for all inventions, models, patents, occupying a floor space not more than four square feet, and a small fee for drawings, blue prints, and the like.

The California Electric Company, the Los Angeles house of the Western Electric Company, will, beginning June 1st, discontinue the use of its present name and be operated under the name of the Western Electric Company.

This business was incorporated October 1st, 1905, through the purchase by the Western Electric Company of the supply business of the Machinery and Electrical Company of Los Angeles and the trade developed in Southern California, Arizona and Nevada has placed it in the front rank of electric supply houses in that section.

The annual report of the General Electric Company for the fiscal year which ended January 31, 1909, has just been issued. It shows that the total sales billed for the year were $44,540,676. The company reports that at the present time its sales are at a rate of about $8,000,000 per year better than they were two months ago. It is stated that at present the rate of business is about $52,000,000 per annum. The improvement seems to be general in all departments. Small equipment has shown better development than have the orders for street railway apparatus and for large installations. The company is still carrying its enormous cash balance, its annual report showing that on January 31 there was more than $22,233,671 in cash on hand.

The Los Angeles office of Allis-Chalmers Company has been moved from the Citizens' National Bank Building to larger and more convenient quarters at 129 East Fifth street. The constantly increasing demand for the company's products on the Pacific Coast has compelled this change and necessitated an increase in the selling force, particularly in the steam and mining lines. J. F. Perry is district manager of the company at this office, and E. H. Knepper, formerly with Ingersoll-Rand Company, has become identified with Allis-Chalmers Company's Los Angeles office in the capacity of salesman. The increased demand for mining and crushing machinery, steam and electrical apparatus, hydraulic turbines, gas engines and steam turbines, has also necessitated a larger selling force at the San Francisco office of Allis-Chalmers Company at 599 Mission street.

The Stanley Hotel at Estes Park, Colorado, one of the most elaborately equipped hostelries in that part of the country, is to be operated entirely by electricity. F. O. Stanley, the proprietor, is sparing no expense in the equipment of the house, and has acquired his own water power, which, at a distance of four miles, will provide enough electric power to not only supply all of the electricity for use in the hotel, but for his own private residence and other cottages in Estes Park. Street lighting will also be supplied from the same source. Mr. Stanley is determined to make this hotel representative of the latest ideas in applications of electricity, and has ordered from the General Electric Company a complete electric cooking equipment for his kitchen; electric water heaters for supplying hot water for the baths, kitchen and laundry; electrically heated mangles for the laundry, flat irons, etc. When open for regular service this summer the hotel is expected to be up to the minute in all of its electrical appointments. It is designed to accommodate between 200 and 300 guests.

NEWS NOTES

INCORPORATIONS.

SANTA ROSA, CAL.—The Red Hill Telephone Company has been incorporated here by H. Ehlers, R. Mazza and A. Richioli.

SANTA ANA, CAL.—The Monticello Oil Company has been incorporated here with a capital stock of $1,000,000 by J. E. McDonald, H. P. Oates, K. A. Snyder and J. B. Merrill.

SAN FRANCISCO, CAL.—The Hartford Oil Company has been incorporated here with a capital stock of $500,000 by C. A. Hooper, D. McDuffie, L. Titus, R. McDuffie and W. Havens.

SAN FRANCISCO, CAL.—The Palmer Junior Oil Company has been incorporated here with a capital stock of $2,000,000 by A. Raymond, A. M. Moore, L. Oppenheimer, H. H. Hart and Aaron Sapiro.

LOS ANGELES, CAL.—The San Bernardino Valley Gas Company has been incorporated here with a capital stock of $1,500,000 by C. J. Hall, H. B. Duncan, W. E. Alexander, W. S. White and R. Bandidi.

SAN FRANCISCO, CAL.—The Fifty-Seven Oil Company has been incorporated here with a capital stock of $500,000 by W. N. Drown, J. F. Leicester, V. C. Osmont, F. S. Thompson, C. N. Black, T. W. Ransom and J. H. Follis.

CRESCENT CITY, CAL.—The Smith River Electric Company has been incorporated here by Charles M. Lindsay, president; D. C. Bemarest, vice-president; A. V. Massy, Carl Sann, E. C. Swartz, E. C. Hegler and Sampel Harris. The new company proposes utilizing the water of Smith River for generating electric power to supply Humboldt county, Cal., and for portions of Josephine County, Ore.

FINANCIAL.

IMPERIAL, CAL.—Bonds to the amount of $50,000 have been issued by this city for the construction of a municipal water system.

PORTALES, N. M.—An election will be held here this week to decide on the issuance of bonds to the amount of $50,000 for the construction of a municipal water system.

MONROVIA, CAL.—A bond election has been called on June 7th, 1909, to decide upon the issuance of bonds to the amount of $134,000 for improving the water and sewer systems in this city.

SAN BERNARDINO, CAL.—The directors of the Lytle Creek Power Company have decided to issue bonds to the amount of $300,000 for increasing the capacity of the electric system throughout the residence section of the city.

MANILA, P. I.—Bonds to the amount of $4,000,000 have been issued in this city, by the Bureau of Insular Affairs, for the construction of a municipal waterworks. Bids for the sale of $3,000,000 worth of the bonds are being received at the War Department, Washington, D. C.

BAKERSFIELD, CAL.—The directors of the Associated Oil Company have decided to issue bonds to the amount of $25,000,000 for the construction of pipe-lines from Coalinga to San Francisco and from McKittrick to Gaviota, on the Santa Barabara coast. Another tank ship will also be built.

SACRAMENTO, CAL.—The Northern Electric Company has succeeded in floating a bond issue of $10,000,000 in Amsterdam. The money is to be used in the construction of a new line to connect the company's line with the present line of the Vallejo & Northern Electric Company in Napa Valley, thus allowing the company ferry connections.

SAN FRANCISCO, CAL.—The Board of Supervisors voted last week a $2,000,000 bond issue for the construction of the municipal street railway on Geary street. This proposition will be laid before the voters of San Francisco in June. Overhead trolley and the most improved and modern types of cars and tracks with 109 pound Trilby rails were decided on. The length of the entire road will be seven miles. The exact estimate of cost was figured to be $1,994,232.

LOS ANGELES, CAL.—The Home Telephone & Telegraph Co. of Los Angeles has sold to an Eastern Banking firm a large amount of its securities, and will devote the proceeds immediately to the betterment and extension of its service. Much new equipment will be installed. The company will complete its South Pasadena lines within sixty days, or less time, giving that place direct connection with Los Angeles. Its 300 pair cables have already been strung to the city limits and 50,000 feet of additional cable has been received. With the new equipment the company will be able to serve several hundred more subscribers in South Pasadena. In addition to the above, the company is rapidly extending its lines in other directions, in order to take care of the rapid growth of the city. For several months past the subscribers' list of the company has been increasing by an average of over three hundred telephones per month.

ILLUMINATION.

OAKLAND, CAL.—Permission has been granted property owners along Telegraph avenue to 22d street, to erect electroliers.

LOS ANGELES, CAL.—The Covina Gas Company has applied for a gas franchise along county highways in Covina, Glendale and Azusa districts.

YUBA CITY, CAL.—The Marysville Gas Company proposes to enlarge its 6-inch mains to 10-inch before July 1st, between this city and Marysville.

GUANAJUATO, MEX.—The Guanajuato Power & Electric Company proposes to have its electric light extension to Silao completed within six weeks.

COVINA, CAL.—G. S. S. Horney and associates, the recent purchasers of the Covina gas company's plant, are making preparations for a number of important changes.

LOS ANGELES, CAL.—The Board of Public Works in this city has awarded contracts for ornamental lighting posts to the Llewellyn Iron Works at $100 a post.

LOS ANGELES, CAL.—In addition to being the first in the State to vote an immense bond issue, $3,500,000, for making good roads, Los Angeles County will probably take the lead of the country in lighting its principal highways at night, using electricity. The first step toward this innovation was taken when the Board of Supervisors asked the District Attorney for a legal opinion regarding the method of procedure. The subject was subjected to the county authorities by petitions from several of the smaller cities for partial maintenance of the lamps on the boundaries which reach outside territory. Along the main thoroughfare are many unincorporated settlements and a large population, and one of the supervisors expressed himself as favoring illumination for all these people, as well as those on the edges of cities, and the sentiment seems to meet with approval. It will be a costly proposition and carried out gradually if decided upon.

TRANSMISSION.

CHICO, CAL.—The Sierra Electric Power Company has been granted a power franchise in this city.

DOWNIEVILLE, CAL.—Walter Painter and Homer Guild have located 15,000 inches of water from the North Yuba river just below this city, for developing electric power.

FRESNO, CAL.—The San Joaquin Light & Power Company proposes to begin work shortly on improving its power lines to the suburban towns near this city. The present capacity of the company's plant will also be greatly increased.

MODESTO, CAL.—Attorney W. H. Hatton and Superintendent Archie Scott of the La Grange Light & Power Company, have made arrangements to purchase a tract of land near Dry Creek, where necessary buildings will be erected for the company.

ASTEC, N. M.—Mr. Andrews of this city has introduced a bill in the House at Washington, D. C., providing that the Secretary of the Treasury spend $300,000 for the construction of an electric power plant at Deming, to furnish power for an irrigation project.

SAN FRANCISCO, CAL.—The Great Western Power Company recently secured the contract for supplying electric power to the Southern Pacific Company for the operation of the latter company's interurban system. The company will begin this work the latter end of the present year.

FRESNO, CAL.—Manager A. G. Wishon, of the San Joaquin Power Company, announces improvements during the coming summer, which will cost upwards of $1,000,000. The capacity of Plant No. 1, which is now 2500 horsepower, will be enlarged by 10,000 horsepower, making a total capacity of 12,500 horsepower which will be available.

TELEPHONE AND TELEGRAPH.

SAN JOSE, CAL.—The Pacific Telephone & Telegraph Company received plans this week for the erection of a telephone building on Market street which will cost $50,000.

RED BLUFF, CAL.—The Forest Service is building a telephone line from Paskenta to Poison Glade, a distance of 20 miles. The extension to Covelle, will be made next year.

SAN FRANCISCO, CAL.—The Postal Telegraph-Cable Company has let contracts for the erection of a one-story concrete cable station, at East 27th avenue and Fulton street, costing $3640.

SONORA, CAL.—The Pacific Telephone & Telegraph Company is engaged this week in building new toll lines which will cost $45,000. Manager Fred Mitchell of the local office is now in Stockton on business connected with the project.

EUREKA, CAL.—Operator Harvy Braun of the Fort Bragg Wireless Station has been notified by the officials of the United Wireless Company that as soon as the station, now being erected at San Luis Obispo, is completed, work will be started on the station on the Mendocino coast near Fort Bragg.

TRANSPORTATION.

SACRAMENTO, CAL.—The Sacramento Electric, Gas & Railway Company began work this week on the construction of its electric line over rights of way to the State Fair grounds.

CARSON CITY, NEV.—H. H. Springmeyer and A. Jensen, have organized a company in this city for the purpose of building an electric street railway to connect with the terminus of the Carson Valley branch of the V. & T. Railroad.

WATER

SAN BERNARDINO, CAL.—The Muscoy Water Company has let contracts for five artesian wells.

LOS ANGELES, CAL.—The local water company proposes to spend $15,000 in improving its system in this city.

OCEANSIDE, CAL.—The Board of Trustees will install 2-inch water mains on certain streets where the pressure is low.

CHICO, CAL.—Guy T. Lewis has purchased property about four miles from this city where he will erect a pumping plant.

OAKLAND, CAL.—The City Council has appropriated $4000 for the cost of constructing a salt water pumping station in this city.

MODESTO, CAL.—President Horace Crane of the Commercial Bank of Turlock, was the lowest bidder for the $53,000 water and sewer bonds.

PETALUMA, CAL.—The Trustees of this city have approved plans for the installation of an auxiliary fire-fighting high pressure pumping plant.

SAN RAFAEL, CAL.—The Marin Water & Power Company announce that its pipe line to Sausalito, which is now being built, will be completed by August 15th.

PORTERVILLE, CAL.—Bids are being received by the Board of Trustees for furnishing this city with material for the necessary improvements to the municipal waterworks.

PORTERVILLE, CAL.—Plans and specifications for the necessary changes in improving the water system of this city have been adopted and bids for construction will be asked for at once.

SAN FRANCISCO, CAL.—A merger is planned between the Spring Valley Water Company of this city, and the People's Water Company of Oakland, which will combine all the outlying properties of both companies.

SAN FRANCISCO, CAL.—The Board of Supervisors have recommended $10,000 for the installation of a testing plant for the 45,000 tons of cast iron pipe, the deliveries of which will begin soon for the auxiliary fire protecting system.

ANDERSON, CAL.—Manager James F. Bedford of the Anderson Water Company states that 3-inch mains are to be laid on the streets where the demand exceeds the present supply and on streets where no mains now exist mains of sufficient capacity will be laid.

SAN BERNARDINO, CAL.—The controversy between the farmers and the Riverside Water Company, the Riverside Highland Water Company and the West Riverside 350-inch Water Company for continuing to divert water from a certain artesian basin, was decided last week in the Supreme Court in favor of the water companies.

OIL.

WHITTIER, CAL.—The Warner Oil Company is receiving bids this week for the drilling of its well No. 10.

RIVERSIDE, CAL.—Reports from Mecca, on the Colorado desert, state that oil indications have been found which are causing considerable excitement.

VENTURA, CAL.—Wm. O'Hara has sold the O'Hara Oil Wells in Santa Paula Canyon to Messrs. Barnes, Simons & Brown of Oakland. The new owners are prepared to spend $100,000 in drilling.

ELY, NEV.—Explorations are now being made in Cave Valley for oil. Over $250,000 will be spent in Southern White Pine and Lincoln counties to determine whether oil exists there in commercial quantities.

TRADE MARKS

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Kierulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher."

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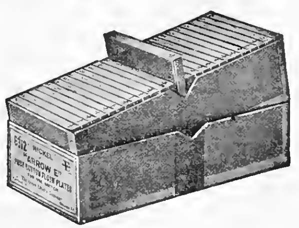

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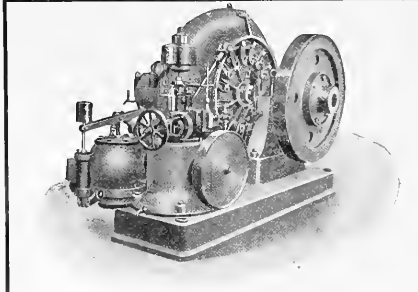

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Replies may be sent in care of the Journal of Electricity Power and Gas *604 Mission Street, San Francisco.*

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.
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Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Ohio Brass."
Pass & Seymour.
Pierson, Roeding & Co., "Locke."
Roebling's Sons Co., John A., "Lima."
Thomas & Sons Co., R.
Western Elec. Co., "Thomas."

Porcelain Insulators
General Electric Co.
Johns-Manville Co., H. W.
Pass & Seymour
Pierson, Roeding & Co., "Locke."
Standard Electrical Works, "Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Electric Co., H. D. Sears, gen'l sales agent.
Western Elec. Co., "Thomas."

Wood Knobs
Blake Signal & Mfg. Co.

INSULATING MATERIAL.

Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co., "Di-electric."

JOURNAL OF ELECTRICITY
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THE REAL PURPOSE OF THE AIR BRAKE.[1]

BY W. S. BARTHOLEMEW.

PART I.

In this paper will be stated the real purpose of the air brake and the method by which this purpose is accomplished. The average person thinks that the air brake is designed merely to stop trains. That was the primary intention, but, as a matter of fact, the field, scope and usefulness of the air brake has broadened today until it is applied to electric cars, passenger trains, and to freight trains for purposes (other than the mere stopping of the trains) which primarily nowadays are so far more important that air brakes would be applied to the trains almost without regard to the expense involved for these other purposes which I will mention.

On electric cars, for instance, in which you are more interested, I think I am safe in saying that the most important feature calling for their application to the average electric car and electric train is the question of time. It would be absolutely impossible to operate cars and electric trains—cars coupled together in trains—on what we call a "short schedule" without air brakes. Many tests have been made along that line which I need not mention, but simply developing the fact that with four motors on a single car, for instance, a motor on each axle, it is possible to get a rate of acceleration in miles per hour per second three or four times as rapid as a stop can be made with the hand brake; and to have the rate uniform in acceleration and—to coin a word—deceleration, it is necessary to employ some power worked through air or some other scheme to secure retardation with as uniform and rapid a rate as acceleration has taken place, and with that accomplished, a short schedule can be made; and that applies to cars operated either singly or in trains.

Type of Locomotive Used in Demonstration.

The next important feature is the matter of current expense. There was a test made in Boston in which I was interested at one time which showed two cars running on the same schedule on Washington street. It required 10 per cent less current to operate the cars with air brakes than cars within a few feet of it with hand brakes. The reason was that the motorman with the hand brakes would keep his hand brake partially set up for fear of running into a team or on a dangerous crossing; whereas the car with the air brakes could be operated with the brakes entirely released.

[1] Paper read before San Francisco Section American Institute of Electrical Engineers, November 27, 1908.

Lastly, is the factor of speed. I shall inadvertently slip into the use of air brake language; I can not help it; and in order that you may be familiar with what I am trying to tell you what we mean in the air brake art, I shall explain the various terms. When we use the word "emergency" we mean that the air brake is to be applied for the purpose of saving life or property. For no other purpose is the emergency application of the brake used. There is almost an entirely different action in "emergency" than in "service."

When it comes to passenger trains, it would be absolutely impossible to operate a train like the twentieth century limited, or the New York-Pennsylvania special without the air brake. You will be interested to know, for instance, that in the case of a train not long since on the Boston and Albany going from Albany to Boston—not a very great distance, as distances go out in this country, there was a failure of air supply, which put the air brakes out of commission, and they operated the train with hand brakes, which caused a loss of time of exactly three hours between Albany and Boston. That illustrates the point that air brakes are applied to trains today for other purposes than to save life and property in other words, to save time. With passenger trains, as with electric cars, to maintain schedules in suburban service or high speed service without some device like the air brake, would be impossible. And in train operation we have another element: Our trains reach such length that we must secure some method of operation in stopping and handling the train en route for slow-downs and stops finally which will handle the train smoothly. One of the great difficulties in handling trains is in the internal pressure and shocks to the train; and the air brake must be so designed that we can handle the train the same in retardation as we can in acceleration; and some of the latest and most important improvements in air brakes have been along those lines. Finally, on passenger trains the air brake is now applied for safety purposes and it is considered the most important appliance in the list of those which are required by law now to be on trains.

In the case of freight trains, there is the question of handling traffic, handling it first as traffic tonnage and then handling it with safety and without danger. In some parts of the report that I shall touch upon later in the talk you will see what the air brake has to do primarily with the question of handling traffic in tons. Anything that can be done to increase the carrying capacity on single-track divisions is, of course, important and valuable to a railroad company in dollars and cents.

The air brake and the electric arts are two arts that have been developed in our lives and contemporaneously; and in some of the features of development they have been very similar. The air brake, it is true, had a little start over the electrical art, as far as the general use of the device is concerned, but there are some features that appeal to me as very similar and having characteristics common to both. In the development, for instance, of your lighting system you remember when we had our little isolated stations, and then the central station, and then a remote power plant, and then a more remote power plant, and each type of installation would be construed by you, in discussing your art, as representing an epoch. In developing your electric railroads, you had your single-truck car and then your double-truck car, and then a trailer, and then they wanted a train of trailers. It took a genius like Mr. Sprague to apply the multiple unit control. Imagine, for instance, what kind of result there would be if we had trains made up of two or more 4-motor cars with a trailer in between with a separate motorman on each motor car, trying to get all the motormen to do the same thing at the same time. Now, what are the common characteristics in those epochs that would be similar to the air brake art? It is those peculiar characteristics of each epoch which had to do with the distribution over large areas or distances. The air brake has been developed through similar epochs. You would be interested to know that the air brake started in about 1868 or 1869, and its use was confined practically to short passenger trains; no great use at that time was made of the air brake on freight trains; and the air brake at that time was called "straight air."

I will show a little later what the difference is between the air brake then, and what it is today. When we began to apply that type of brake generally we ran against some inherent difficulties and the one particular thing which was a fatal defect was that it had a very low factor of safety when we applied "straight air" to cars connected together in trains. By "straight air" we mean simply a set of piping through the train connected to the brake cylinders through which the brake cylinders are connected up with the air supply on the locomotive and the air admitted direct to those cylinders to apply the brake shoes to the wheels. You can readily see that if the main pipe became disabled the whole system went out of commission; and there was no warning of danger until they came to use it. The second inherent difficulty with that type of brake was what I wish to term, and which I shall use throughout the talk to some extent, the "serial action time element." We mean by that, the time at which an action occurs on each vehicle in the train. Now, with straight air, and with the very small piping which they used on the cars at that time—say half an inch, or not to exceed three-quarters of an inch for the main pipe line, as against the standard of one and one-quarter inches today between the application on the first car and the fifth and those behind, there was a difference in time that made an internal shock that was very great. So that it was not long before a requisite was apparent for something different. Mr. Westinghouse perceived it and proceeded to develop what we now call the "automatic brake."

It was then, and is now, called the plain automatic brake; but, before I touch upon that particular feature of it, I want to tell you the dividing line between the epochs to correspond, in a sense, to those I have mentioned as being in your art. When we came to apply the air brake to freight trains, which were at that time not to exceed 30 cars long, it was almost impossible to get satisfactory results from a straight air brake; so that we had then a plain automatic brake, which was designed for use on trains up to 30 cars. When this brake was used to some extent—probably 150,000 or 200,000 in use, which was a good many at

that time (that was in the early '80's)—it soon became evident that even its action through a 30-car train had shortcomings, especially as far as emergency action was concerned, and the railroads began to feel this shortcoming; and it became necessary to develop a function in the equipment to care for longer trains. This was termed the "quick action" feature. Then they were ready for a 50-car train, and that brake was developed about 1887 and continued to serve satisfactorily up to the time that 50-car trains ceased to be the common standard. When we got to 80 or 90 or 100-car trains it was just as necessary to have some further improvements as it was to step from 5 to 30 or 30 to 50-car trains. We have common today 80, 90 and 100-car trains; and all our experiments made this summer were made with 80-car trains. So that the individual characteristics of the air brake of those epochs, of the 5-car, the 30-car, the 50-car and 80-car trains have to do with the securing of action through an extended length of train, just as your development in the lighting and electric train end. In order to explain what we mean by this differential in the brake pipe itself, I want to mention that when we have this 3,700-foot brake pipe line charged to 80 pounds and we would lower that pressure 5 or 10 pounds with the desire to get a corresponding reduction at the back end, with electricity the action would be instantaneous, but with compressed air it sort of tapers off until it remains unchanged temporarily, at least, at the rear end, either up or down; so that we would have a sort of triangular pressure, say 70 at one end and 80 at the other, and we would have a gradually developing differential through the pipe in either direction. Part of what I will tell you tonight will have to do with this peculiar condition of the differentials in the brake pipe.

Instead of considering that as a shortcoming and something that we regret exists inherent in compressed air for this purpose, we now use it. We now make the triple valves; and they are called so because they do three things: They charge the system, they make the brake application and they release the brake

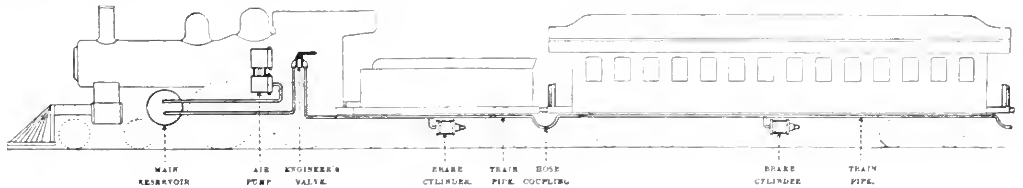

Fig. 1. The Straight Air Brake as Applied to a Train.

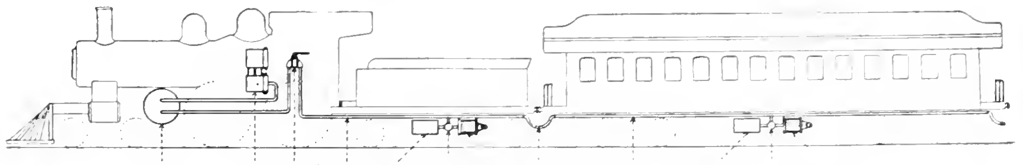

Fig. 2. The Automatic Air Brake as Applied to a Train.

operation has changed in characteristics from one type of operation and one type of lighting system to another.

In the electric art you have the advantage of having electricity instantaneous in operation through very extended areas; but when we come to work with compressed air, with which some of you are more or less familiar, you appreciate that we get a new element, a time element—which you do not have in the electrical art. We have one thing that is quite similar, and that is, that we have a loss at the end of the line, which we call a "differential." You call it in your art, I believe, a "drop" in the line. We have known, of course, since we began to use compressed air, that the differential existed, as the entire operation of the air brake depends upon the differentials of pressure, but we have only developed the art within the last few years to utilize the differential which exists between the pressures in different parts of the brake pipe itself to perform valuable functions. On the train this summer on which we made our demonstrations there was a brake pipe 3,700 feet long, the natural friction in which, of course, created a differential between front and rear

cylinder pressure [illegible] the brakes through [illegible] the triple valves [illegible] end of the [illegible] and the third function [illegible] three [illegible] as far as they are concerned [illegible] the differential perhaps does not exist. They are doing entirely different things at the same time. [illegible] as engineers, that during the development and [illegible] of the air brake [illegible] that we did not use that differential [illegible] existed as a shortcoming [illegible] a stumbling block to the securing of the results that we desired. [illegible] the [illegible] to use those [illegible] pressure [illegible] operating [illegible]

There is [illegible] in regard to [illegible] art and the [illegible] art [illegible] standardization [illegible] It constitutes [illegible] an engineering difficulty. When you work out problems in your [illegible] if you have individual necessities in some installation, long distance transmission, some [illegible] condition, or something of that kind, you can treat it specially according to

the particular features of the physical conditions pertaining, and also according to your own ideas of what ought to constitute the proper treatment for those conditions. Now, with our art we are limited; and we are limited by five very important things. What would you think, for instance, of being obliged to make everything standard with and work with every electrical installation that has been made since 1887? In our art every air brake that is developed, every installation that is made, must work absolutely harmoniously with every installation that has been made since 1887; and some of them as early as 1883 will still work harmoniously with the air brake installations of today. That has done a great deal to stultify and keep down development in our line. It has made it impossible for the art to spread out. There are a dozen different ways, perhaps better ways, of doing the things that I am telling you about tonight as having been done; but when you see the five limitations that a new man in the art, starting out independently to work at the air brake, has to meet, he has a pretty hard fight, and we are up against the same thing. We would like to throw all of the old ones away and start anew, but with 3,500,000 installations we are limited as follows:

First, there are the hose connections, and by that we mean the entire pipe throughout the train. The hose connections are there and every car, passenger or freight, in the United States, from the White Pass & Yukon railroad in Alaska to the Florida East Coast railroad in Florida, can meet any one of the other 3,000,000 or more cars in the night and be coupled together and operated. Those hose connections must be used; they will not allow us to change them. Every air brake must work on those present hose connections. That is settled and settled forever, and they will probably remain as long as we all live, that probably can not be changed.

The second condition that exists is: All improved air brakes must work with the old equipment. In fact, the very first question that is always asked when we come to explain a new development in the air brake art is: "Will it work harmoniously with those already on the cars, especially foreign cars?" Mr. Kruttschnitt said to me: "Suppose we change all the Harriman lines cars? Sixty-five per cent of our cars are foreign cars"—and by foreign cars we mean cars from another road—"65 per cent of the cars going over the mountains are cars of other roads. The foreign car installations in that particular train are in the majority, and, unless we get all the other cars in America to change"—which, as I said just now, consists of about 3,500,000—"we could not do anything." I explained that the improved equipment not only would work with the old harmoniously, but that it would improve the operation of any and all equipment on the balance of the train.

The third and more important thing is: They must not only work harmoniously, but they must be capable of being interchanged. The car builders have rules for standards which require that if a triple valve becomes defective, the road on which that car then is can apply its triple valve in place of it. That makes it a necessity that the triple valve in use by any road must go on to the cars of any other road; I mean physically; not only work with, but physically interchange; they must meet the master car builders' conditions.

The fourth condition is that any improvement which we inject into a piece of air brake apparatus must, of necessity, make an improvement in the operation of the old equipment that might happen to be on the adjacent vehicles, i. e.: During the transition period, for instance, we must begin to get the benefit of any improvement not only on that particular vehicle on which the improvement actually exists, but the improvement must be spread over the entire train in which that vehicle might happen to be, and the greater the extent to which it is spread on all that train by the effect of the improvement being on only a few vehicles in the train, the more important that improvement is.

The fifth condition which limits us is that any improvement which may be designed must be of such nature, such design, such style and physical construction that the old equipment can be taken into the works and have those improvements added without the necessity of discarding much, if any, of the old apparatus.

A Demonstration Train. The Dynomometer Car Follows the Tender of the Locomotive.

When you come to consider those five limitations you will begin to appreciate why the air brake art has been limited in America to one or two companies. The equipment for freight cars which we supply absolutely meets all of the conditions which I have outlined.

We have in our archives in Pittsburg many improvements. Some of them we have not used and on which the patents have run out. They did not meet two or three of the limitations that I have outlined. There is not very much encouragement, therefore, for an air brake inventor. A new air brake was explained to me by one of the officials of the Southern Pacific Company that has excellent features. But there is no possibility of its being marketed, as a general proposition. They might be used in some particular place under some special conditions where they might use special equipments; but, outside of such special conditions, so far as general interchange throughout the United States is concerned, we must absolutely be confined to the five limitations outlined.

As I said, just magine in your art making every dynamo, motor and transmission line interchangeable since 1887. It would be an absolute impossibility in your art. But we are confined in our art to those

particular things, to the disadvantage of the air brake art.

You will be interested, however, in learning that we have reached the parting of the ways, as far as passenger equipment is concerned.

When we had passenger cars weighing 60,000 to 80,000 pounds each and speeds of from 20 to 40 miles per hour, we had conditions that made it necessary for us to do certain things; but when we double the weight of that equipment and double the speed, we find entirely new conditions coming in that we have been obliged to meet, and the new and improved air brake on passenger trains will not meet the five conditions only in that it will not physically interchange with the old simply because the passenger cars remain on the home line with very limited exceptions and the foreign car interchange is not as important a consideration as in freight trains. The Pullman company, in adopting the new equipment, opened the way for other roads to utilize them, the new and old equipment harmonizing perfectly, so far as operation is concerned, the Pullman cars constituting the great part of the foreign cars in passengers trains.

Another difficulty that confronts us in the use of compressed air as against electricity, for instance, is the time necessary to restore the pressure. In electricity the moment you shut or open a switch you have a change instantaneously; but the moment we open a valve we get a time factor that is almost impossible to avoid before a differential occurs. Those are some of the difficulties we are confronted with.

I might confess here also that there are inherent shortcomings in the air brakes; but we have permitted them to remain exclusively on what we call the "release" side of the equipment—shortcomings that are a necessity in the development of the art through the engineering difficulties that exist—some of which I have mentioned. The time element that comes with the use of compressed air makes it impossible to do one thing as quickly as another, and if we have a choice we always leave that shortcoming on the release side of the equipment. That is the reason why you have been delayed many times by what the train men call "stuck brakes." It is a good deal harder to get the brakes off than on. But some of those inherent defects are in there because nobody can help it, because the limitations of the art which I have outlined are such that it is impossible to do everything as well as we should like to do it.

Some people, in fact most people, have an idea that the air brake is kept off in some way by a set of springs on the car. There is such a brake in which the compressed air holds the brake shoes away from the wheel and a spring applies it; and there is also an air brake that has been developed in which the air holds it applied and the spring releases it. But in the air brake as we commonly understand it, neither occurs in a certain sense, the only springs used are the springs to overcome the natural friction which would cause the shoes to lie up against the wheels by gravity. The brake shoes are suspended by perpendicular hangers and they do not always come as free from the wheels as we should like. We must overcome that spring before we can get the shoes up against the wheel to do business. To that extent only do we use springs in the air brake today. The release spring merely has to do with the preventing of the parts remaining at rest in a certain position.

(Part II of "The Real Purpose of the Air Brake" will appear in our issue of May 29th.)

EMPLOYES TO BECOME STOCKHOLDERS.

Mr. Jay P. Graves, president of the Spokane & Inland Empire Electric Railroad Company, operating interurban lines in Washington and Idaho and power plants in and near Spokane, has addressed a letter to the officers and employes of the entire system, setting forth a plan by which they may become stockholders and share in the company's profits. The letter follows:

"A number of corporations in the United States, have, during the last few years, adopted plans whereby their employes were afforded opportunities for acquiring their stock or securities on safe and easy terms, believing that thereby employer and employe were brought closer together to their mutual benefit.

"Believing thoroughly in the principle, and desiring to bring about and maintain between this company and its employes a community of interest and consequent good feeling the company has arranged with the Union Trust Company of Spokane to supply to any officer or employe of the company shares of its preferred stock at the going market price, plus an interest which may have accrued on the purchase price between the time of purchase by the trust company and its sale, and a commission of 5 per cent on the amount purchased. No profit is made by the trust company except the commission, it purchasing the stock in the market and selling it to the purchaser at cost.

"Easy terms will be made, the purchaser paying not less than 15 per cent of the purchase price in cash, and the deferred payments being arranged to suit the purchaser, provided that not longer than five years' time will be allowed, the deferred payments bearing interest at 5 per cent per annum. In case the purchaser becomes sick or disabled, leaves the service of the company, is discharged, or dies before the stock is paid for, the Union Trust Company will, if requested to do so, cancel the contract and repay to the purchaser, or in case of death, to his heirs, all sums paid on account of the purchase price. After the purchase is completed, the company will, in any of the events above stated, take the stock off the hands of the purchaser, or his heirs, at the price paid for same, plus 5 per cent per annum interest and less any dividends on the shares that may have been paid.

"The par value of the shares is $100, the selling price by the trust company to be the cost plus commission and interest. Holders are entitled to dividends at the rate of 5 per cent per annum before dividends are payable to holders of the common stock. Above 5 per cent, up to 7 per cent the two stocks share equally in dividends. The shares are redeemable at any time by the company upon the payment of $135 a share and accrued dividends. Owing to the recent financial depression, it is believed that the shares can now be purchased for less than par."

Mr. Graves states that the company's object in offering the foregoing plan is that the employees may become interested in the enterprise and better their condition by sharing in its future success, adding:

"The arrangement entered into with the Union Trust Company provides the most liberal terms, the credit of the Spokane & Inland Empire Railroad being back of every employe wishing to purchase stock on time payments."

GATUN POWER PLANT

[illegible]

Floor Plan, Gatun Power Plant

[illegible]

The power plant in question has a dual purpose. Primarily, it will furnish the power for running the single and the duplicate unloading cableways which operate over the material berm and the cement sheds, and for operating the electric cars which will carry material to the concrete mixers, running a battery of eight 2-cubic yard concrete mixers, running the cars that will carry concrete from the mixers to the unloading cableways which reach over the lock site, supplying power for operating two duplicate cableways which will take the concrete from the cars and deposit it at any point desired on the lock site, and supplying current to three seventy-centrifugal dredge relay pumps, under direction of the hydraulic construction of Gatun Dam. Its secondary use will be to supply electric current for lighting Gatun, Cristobal, Mount Hope, and Gatun, and power for running the manufacturing plant of the Subsistence Department at Cristobal. After the Canal is in operation it will be held in reserve to operate the locks and Canal machinery in case the hydraulic power plant should fail either from accident or from lack of water. The hydraulic electrical power plant will be run by water received from Gatun Lake, while the [illegible] plant which is now being erected will [illegible]. The building for the power plant [illegible] and all machinery excepting the [illegible]

[illegible]

[illegible] each transformer having a primary voltage of 2,200, a secondary voltage of 490 and a capacity of 175 k. w. For supplying air for the transformers, two volume air blowers with direct coupled motors, having a capacity of 10,000 cubic feet per minute each at ¼ ounce pressure to the square inch, will be installed. In the basement beneath the machinery is an air chamber into which air will be forced by the blowers, to escape through flue openings in the floor. There is one flue under each transformer and reactance coil, and air passing through these machines will carry off the heat due to electrical losses. Three rotary converters, a set of three transformers and one reactance coil, complete the three units of this part of the plant. One of these converters has a capacity of 300 k. w., and the other two of 500 k. w. each.

Between the units of transformers, reactance coils and rotary converters, and the boiler room wall are located a controlling benchboard, an exciter switchboard, a feeder switchboard, and an air compressor. The turbo-generators are controlled from the controlling benchboard and all indicating instruments in connection with the generators and feeders are located on it. The air compressor is motor driven and supplies air at 150 pounds pressure to the square inch for the blowing system for cleaning the electrical equipment and to the boiler feed pump air chambers. Along the south end of the electrical room are located the G. E. type K form 37 oil switches by means of which each of the turbine generators and rotary converters is connected with the station bus. To this bus are connected switches of the same type controlling the feeder circuits for power for the entire handling plant.

CURRENT COMMENT

Totem pole electroliers [illegible] feature of the Seattle [illegible] them. These totems [illegible] beak of the bird [illegible] will be placed [illegible]

Patent Records Were Broken on April [illegible] and 27th of this year. Patents [illegible] 27th aggregated [illegible] of these [illegible] patents [illegible] electrical, 47 being assigned to the General [illegible] Company.

Cheap power [illegible] according to a recent [illegible] loops, B. C. [illegible] power [illegible] consumed with an average [illegible] To this was added [illegible] per cent for [illegible] aside from meters, so that the [illegible] out well under one cent per [illegible]

Destruction of Canadian Telegraph Systems, [illegible] particularly in the Yukon and northern British Columbia due to damage from [illegible] blizzard, may bring about the installation of [illegible] systems where such trouble [illegible] year [illegible] receipts were $122,122.[illegible] expense account of $[illegible]

The conservation of water power [illegible] issuance of an order from the Department of the Interior, Washington, D. C., that the [illegible] Geological Survey [illegible] certain [illegible] are in the public domain and [illegible] of the national forests for the purpose [illegible] step [illegible] necessary to [illegible] Congress to control and [illegible] these sites.

The California Railroad Commission, [illegible] commenced [illegible] formulating [illegible] of traffic on both electric and steam railroads operating in California, following [illegible] precedent of the Interstate Commerce Commission. [illegible] jurisdiction of the commission [illegible] railways has been questioned, the [illegible] brought up by the Pacific Electric Company [illegible] Angeles, the Oakland Traction Company [illegible] Sacramento Gas, Railway & Electric Company of Sacramento.

The new side-rod electric locomotive [illegible] described elsewhere in this issue represents [illegible] in all of its mechanical details to [illegible] steam locomotive practice. The wheel arrangement with a four-wheel bogie truck at one end [illegible] of coupled driving wheels and [illegible] pony truck at the opposite end [illegible] as that commonly designated as the "Pacific" type by steam locomotive designers and is the type which has been generally adopted for [illegible] passenger service. With the exception of the bearings for the jack-shafts to which the [illegible] are attached, the trucks, frames, spring equalizing system and the wheels and axles are precisely the same as are used on a steam locomotive.

Electrification of Berlin railways [illegible] under consideration by the [illegible] Railway Administration. The [illegible] of the circle and suburban [illegible] the erection of two large power plants.

The Alaska telegraph service will be reinforced by [illegible] who left Omaha on May [illegible] completed their course in telegraphy [illegible] They will relieve men who have [illegible] Alaska and take up the work [illegible] existing telegraph [illegible]

Government Fire Patrol in Southern California [illegible] of the existing telephone [illegible] being made to hurry [illegible] of the fact that [illegible] and the danger from [illegible] during the past [illegible] has been installed, [illegible] practically all [illegible] The work has been done [illegible] by a telephone [illegible] Although [illegible] fire patrol service [illegible] when such [illegible] of the government.

The duty on carbons [illegible] interested of the [illegible] The New [illegible] of the [illegible]

[illegible] mention the other [illegible] the duties on carbons for [illegible] 90 cents per 100 [illegible] changed [illegible] 35 per cent ad valorem. [illegible] a specified [illegible] again [illegible] the experts of the finance committee [illegible] the introduction of [illegible] word [illegible] comparative estimates wrote [illegible] 46.75 per cent, while the [illegible] In other words there [illegible] a hundred pieces. But [illegible] imported in two-foot lengths [illegible] $1.30 a hundred instead [illegible] that [illegible]

[illegible] of the above point in the [illegible] for the Finance Committee [illegible] 100 feet on carbons [illegible] and [illegible] cents per 100 [illegible] light purposes.

This [illegible] like a material reduction [illegible] per 100 feet [illegible] of petroleum coke are neither [illegible] In other words [illegible] imposed on an article [illegible] which is imported [illegible] as much [illegible] as it would be at 70 cents per 100 feet.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Perhaps the most notable addition to the literature regarding the mechanical operation of railways that has appeared in recent years is the report on an exhaustive series of tests on the air-brake equipment of an eighty-car train on some of the heaviest grades on the California system of the Southern Pacific Railroad. To a railroad man this bulky report is replete with valuable information. But like many an unfamiliar subject it requires an equally voluminous explanation to be understood by the uninitiated. Such interpretation has been made by Mr. W. S. Bartholemew in the course of an informal talk before the San Francisco Section of the American Institute of Electrical Engineers which begins in this issue.

Train Control

One of the most novel features emphasized is that the essential function of the air brake is not so much to stop cars as it is to facilitate their movement. This is particularly requisite in the case of electric traction where cars must be run on short schedule with frequent stops. A further demand is that of increased carrying capacity with corresponding safety. The main object of the tests was to demonstrate the fact that the new type L, triple valve air brake minimizes the damage to goods and car structure.

In tracing the development of the air brake from its rudimentary stage it is shown that the difficulty to be met has ever been one of increasing area or distance, thus resembling the corresponding problem in the case of the transmission of electric power. The great trouble has been the drop in pressure or "differential" which occurs with increasing length of trains to be handled. It is interesting to note the manner in which this apparent shortcoming was finally used to actuate the triple function of the latest type of brake, first in charging the system, then applying the brake, and finally in releasing the brake pressure. This has all been so nicely adjusted that a long train can be brought to a standstill within its own length without serious jar, each car stopping simultaneously. On the reverse the train is started without breaking in two. This problem is complicated by the element of time necessary to restore pressure,—the inertia, as it were, whereas electric action is almost instantaneous. Furthermore, there is the question of standardization which requires that the system be applicable to any type of equipment, whether new or old. This is like making interchangeable every dynamo, motor and transmission line made in the last twenty years.

The results show that much greater tonnage can be safely handled on heavy grades, thus accelerating the movement of traffic over congested mountain grades. An eighty-car train running at thirty miles per hour was stopped in 1700 feet with a reduction of only five pounds in train-pipe pressure.

Incidentally the paper contains one of the best tributes ever paid to the advantages of oil over coal firing in maintaining speed uniformity, the fireman being able to keep steam at a predetermined pressure from the beginning to the end of the run. The final result stands as an object lesson as to what may be accomplished against what are apparently insurmountable difficulties.

PERSONAL.

C. A. S. Howlett of the Western Electric Company, Chicago, has been elected president of the National Sales Managers' Association.

Ernest B. Kost has resigned from the staff of the Washington Water Power Company to become commercial agent of the Northern Idaho & Montana Power Company, with headquarters at Sandpoint, Idaho.

G. I. Kinney of the San Francisco office of the Fort Wayne Electric Works, is distributing an excellent brand of cigars among his numerous friends in commemoration of the arrival of a 9¼-pound baby boy. The youngster's first birthday was May 19th, 1909.

A. W. Hitchcock, in charge of the insurance inspection of the Western Electric Company, with headquarters at New York, is now in San Francisco making his annual inspection of the property of the Western Electric Company on the Pacific Coast.

A. S. Kalenborn, formerly with the California Gas & Electric Company, San Francisco, is now located in Reno, Nevada, engineer of operation and construction for the Truckee River General Electric Company and the Reno Power, Light & Water Company.

J. L. Muller, who filled the position of chief clerk of the Western Electric Company, San Francisco, during the exciting days following the San Francisco fire and who has more recently been connected with the St. Louis house of the Western Electric Company in the same capacity, recently severed his connection with that company and is now filling a position in the clerical department of the American Telephone & Telegraph Company, Boston.

F. H. Poss of the San Francisco office of the Holophane Company leaves for the East on June 2d, where he will attend the annual convention and summer outing of the Sales Department of the Holophane Company at Association Island, New York. He will then visit the factory of the Holophane Company and several important cities of the East, returning to San Francisco after a trip to cover a period of about four or five weeks.

R. B Daggett, Pacific Coast manager for the Electric Storage Battery Company, Philadelphia, Pa., has returned from an extended trip throughout the Northwest in which he covered Portland, Tacoma, Seattle and Spokane. While in Portland and Seattle Mr. Daggett participated in the meetings held by those interested in the electric vehicle industry in the Northwest and reports a great deal of enthusiasm in this direction.

A telegram brings the welcome news that T. E. Bibbins of the San Francisco office of the General Electric Company won the National Cup in the Golf Tournament of Sales Managers of the General Electric Company, held at Pittsfield, Mass., under date of May 18th. The match was participated in by all the company managers in the United States and is an important annual event with this company. The numerous friends of Mr. Bibbins on the Pacific Coast are very much elated over the news and numerous congratulatory telegrams have been sent him. This is the second cup that Mr. Bibbins has won so far during the present month, he having been the victor in the tournament of the Pacific Coast Electric Jobbers recently held at Del Monte, Cal.

W. F. Goble has been appointed superintendent of the mechanical department of the Los Angeles & Redondo Railway, Los Angeles, Cal. Mr. Goble entered the employ of the Los Angeles & Consolidated Electric Railway, which later became the Los Angeles Railway, as a car repairer in August, 1892. In 1894 he was appointed night foreman of the company, a position from which he resigned in 1897 on account of ill health. In 1898 he entered the employ of the Main, Fifth & San Pedro Street Railway, Los Angeles, as mechanical foreman. Subsequently the property of this company was purchased by the Los Angeles Railway and he again entered the employ of the Los Angeles Railway, this time as an inspector in charge of the overhauling work. When the Pacific Electric Railway opened its Long Beach line Mr. Goble equipped the cars for service and remained with the company as general car inspector until 1903, when he again entered the employ of the Los Angeles Railway as general foreman under Mr. E. L. Stephens, master car builder of the company. On January 1, 1907, Mr. Goble was appointed general foreman of the Los Angeles & Redondo Railway, and on April 1, 1909, was appointed superintendent of the mechanical department of the company.

OUTING OF THE CONTRACTORS.

The San Francisco branch of the National Electrical Contractors' Association will hold its tenth annual outing at Fairfax Park on Saturday, May 29th, 1909.

The following joint committe is in charge of the outing: W. S. Hanbridge, C. E. Wiggin, P. Decker, L. R. Boynton, W. W. Hanscom.

An interesting program has been arranged which will offer opportunities for every one in attendance to win a prize. The program is as follows:

9:00 a. m.—Leave via Sausalito Ferry.
10:00 a.m.—Arrive at grounds.
10:00 a. m. to 12 m.—Make yourselves at home.
12:00 m.—Lunch.
1:30 p. m.—Ball game between the Jobbers and Contractors.
2:00 p.m.—Races:
First—Men's heavyweight.
Second—Women's middleweight.
Third—Men's lightweight.
Fourth—Women's lightweight.
Fifth—Boys 16 to 20 years.
Sixth—Girls 12 to 15 years.
Dancing all day in the pavilion.
5:00 p. m.—Distribution of prizes.

Outings held in previous years, particularly 1908, have been very successful but the committee in charge claim that the coming outing will eclipse them all.

The weather department has been consulted and assures a pleasant day with no possibility of rain. Every electrical house, including Jobbers as well as Contractors in the Bay cities will close on May 29th and turn out in a body and the contractor for one day at least will be supreme.

GENERAL ELECTRIC COMPANY'S BALL TEAM DEFEATED.

The baseball team of the San Francisco office of the General Electric Company met its waterloo on May 8th when it was defeated by the team of the John A. Roebling's Sons Company in a spectacular thirteen inning game by a score of six to five.

The Roebling team has a number of victories to its credit annexed this year from the businessmen's teams and is willing and anxious to hear from other possible victims

NEW CATALOGUES.

The Ohio Brass Company, Mansfield, Ohio, has issued catalog No. 20, which is devoted entirely to catenary construction. This catalog not only illustrates materials in detail with numerous views of installations, but also contains much valuable information on engineering features. The latter data gives the proper calculations and allowances to be made for different forms of catenary construction and for the ordering of material.

TRADE NOTES.

Pacific Electric Railway, Los Angeles, Cal., it is reported, will build 50 new cars in its own shops.

The Record and Guide of New York City is forwarding to its subscribers a list of buildings that are to be erected in New York this year which will amount in round numbers to about $75,000,000.

The Allis-Chalmers-Bullock Company have the contract for putting in the turbine and generator at the city power plant of Nelson, B. C., to complete the second unit at Bonnington Falls. Estimated cost, $75,000.

Evans & Dickson, electrical engineers and contractors, Tacoma, Wash., have leased a large room at 721 Commerce street for a warehouse and shop for construction work and are fitting it up with machinery and stock.

The San Francisco office of the Standard Underground Cable Company of Pittsburg, Pa., will, on about June 15th, move from its present location in the Shreve Building, to the new First National Bank Building.

The contract for the police signal patrol system for Vancouver, B. C., has been awarded to the Gamewell Company, an American concern, at $12,647. The Northern Electric Company of Canada tendered at $12,200.

The Metal Finishing Company of Union City, Conn., manufacturers of Insulator Pins, Brackets and Cross Arms, announce the opening of a New York office at 24 State street, in charge of Messrs. L. W. Brownrigg and C. M. Stevenson.

The Holabird-Reynolds Electric Company of San Francisco are making preparations to occupy the new three-story and basement building, 523-525 Mission street, now under construction especially for them, and which they expect will be ready for occupancy some time in July.

The Oregon Electric Railway, Portland, Ore., has begun work on its depot at Forest Grove. The building will be in the shape of a triangle and will be 91 ft. 6 in. x 16 ft. on the west end and 52 ft. 10 in. on the east end. There will be 44 ft. on the west end occupied by waiting room and ticket office.

The American Conduit & Manufacturing Company, Pittsburg, Pa., announce the appointment of Otis & Squires, 155 New Montgomery Street, San Francisco, as their Pacific Coast agents. This company manufactures wireduct, the new flexible conduit recently placed upon the market. A complete stock will be carried in San Francisco.

The Holabird-Reynolds Electric Company will open a supply house in Seattle, Wash., on June 1st, where a general stock of electrical supplies, including the various lines for which they are agents on the Pacific Coast will be carried. This house will be under the management of E. J. Dwyer who has for some years occupied a position with the San Francisco Sales Department.

For the ten months ending January, 1909, Canada's imports in electric motors, generators and sockets totalled $270,000. Out of this $245,000 came from the United States, while $17,000 was imported from Great Britain. In other electric supplies United States exports to Canada amounted to $1,300,000 Great Britain sent in $49,000. Germany and France supplied almost the same amount of $4,000.

One of the features to be carefully looked into where electric switches are concerned is simplicity. If all the little springs and catches can be done away with a great deal is accomplished.

Krantz Manufacturing Company has lately placed before the public a ceiling switch which is simplicity itself. It is worthy of consideration.

The Holabird-Reynolds Electric Company of San Francisco have augmented their selling force materially during the past week by the addition of J. E. Crilly, formerly with the Brooks-Follis Electric Corporation, and R. Holterman, recently connected with the California Electric Construction Company and George Battee of the John G. Sutton Company.

The Dean Electric Company, manufacturers of telephone apparatus of Elyria, Ohio, will make no exhibit at the coming Alaska-Yukon-Pacific Exposition, but in lieu of such an exhibit are calling attention of the trade to the numerous plants installed by them in and around Seattle that can be conveniently reached by a short trip and will well repay a visit.

The Westinghouse Electric & Manufacturing Company will make no special exhibit at the coming Alaska-Yukon-Pacific Exposition, but will call the attention of visitors to the installation of the power house on the Exposition grounds which is completely equipped with Westinghouse apparatus and three bar wound secondary induction motors driving the centrifugal pumps for furnishing water to the Exposition grounds.

The Moran Engineering Company, Inc., general contractors, engineers and machinery merchants, of Seattle, are temporarily located in the Maynard building. On July 1 they will move into their own building, at 1242 to 1246 First avenue south. John W. Moran, president, is a son of Robert Moran, one of the founders of the Moran Company. James D. Mudge, vice-president, and Harold G. Stem, secretary, were formerly managers of the engineering and machinery departments, respectively, of the Caldwell Brothers Company; all are well and favorably known to the general trade.

The D'Olier Engineering Company, Philadelphia, has secured a contract from the United States Government for a complete hydro-electric plant at Fort Yellowstone, Yellowstone National Park, including penstock and concrete power house. This installation will be used for furnishing light and power throughout Yellowstone Park and will consist of three 150-kw. alternating current, 3-phase, 60-cycle generators, each direct connected to a 280 horsepower D'Olier Francis turbine water wheel which will operate under a head of approximately 275 feet. A complete switchboard and the transmission wiring are included in the contract.

The Dean Electric Company of Elyria, Ohio, have closed a contract with the Rochester Telephone Company of Rochester, Indiana for a complete common battery multiple central office equipment. The apparatus includes an immediate installation of seven hundred lines with fifteen hundred ultimate and forty-five rural lines; a main distributing frame; relay rack; wire chief's test panel and power plant are included in the contract.

In conection with the above equipment they will install at the same time one of their standard No. 18 cabinets to handle an ultimate capacity of 40 toll lines.

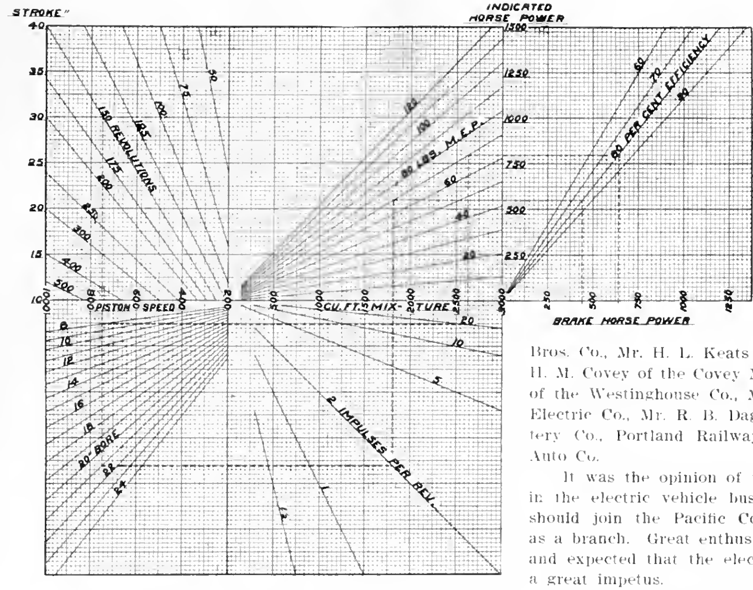
Preliminary reports for the month of April of the business done by the Western Electric Company show that it was considerably better than for the month of March, which in itself had been the best month since the beginning of the fiscal year, December 1, 1908. While it is stated that the company is consuming considerably more copper than it did several weeks ago, it is not as yet taking more than 50 per cent of the normal amount. A representative of the company stated that the business in all branches was very satisfactory, that orders were coming in rapidly and that the plants were increasing the number of workmen every day. Business for telephone apparatus has been especially large, and many valuable orders have been received for equipment and for switchboards.

GAS ENGINE HORSEPOWER AND CYLINDER DIMENSION DIAGRAM.

BY LEIGH M. GRIFFITH.

The estimation of the power capacity, or inversely, the determination of cylinder dimensions, of internal combustion engines is more inexact and requires a larger experience to secure satisfactory results than do like calculations when steam is the working fluid. This is particularly true when the engine under consideration differs materially in size or construction from existing machines which have yielded the test data to be used. Even, as in the great majority of cases, where the design conforms closely to what may be called standard practice, approximate results only can be obtained.

When, however, calculations are based on carefully obtained test data of existing machines of identical design and of both larger and smaller capacity than the unit under consideration, the probable error will be reduced to the minimum. Generally, where proper consideration has been given to the variables and problems peculiar to the case in hand, results close enough for ordinary commercial purposes are not difficult to obtain.



Cylinder Dimension Diagram.

In the accompanying diagram is shown a means of quickly getting rough values of the principal cylinder dimensions and engine functions. The variables involved naturally arrange themselves in groups thus:

Cylinder bore,
Piston speed................Stroke and revolutions.
Impulses per revolution,
Indicated h. p...............Brake h. p. and mech. efficiency.
Mean effective pressure.

The complete solution involves the knowledge or assumption of four of the main group and one of each secondary pair. The diagram may be used to obtain values of any variable if a sufficient number of the remainder are known or assured.

The cubic feet of mixture values should be decreased by from 8% to 35%, depending on gas velocity, valve design, etc. When using the diagonals of 5, 10 and 20 impulses per revolution, divide the result by 10, as they are simply inserted to give increased accuracy to the small readings. In the absence of reliable data, values of the mechanical efficiency and mean effective pressure may be assumed with the following table as a guide. The figures are based on good design and on the range of sizes commonly run with the fuel named.

Fuel burned.	Mech. Eff. %	M. E. P. lbs.
Producer gas	80 to 85	85 to 95
Lighting gas	76 to 80	80 to 100
Gasoline and light distillate.....	75 to 82	75 to 105

THE ELECTRIC VEHICLE IN THE NORTHWEST.

In line with the general interest shown in the electric vehicle industry throughout the entire country those associated with this line of business in the Northwest are doing some active work towards the development of the electric vehicle business.

A preliminary meeting to discuss the situation was held at Portland, Ore., on the evening of April 22. Mr. H. L. Keats of the Keats Automobile Company of Portland took the initiative in the movement, the first meeting being held at the Commercial Club, which included a dinner and an entire evening spent in discussing the subject.

Those present were: Mr. A. C. Downing of Studebaker Bros. Co., Mr. H. L. Keats of the Keats Automobile Co., Mr. H. M. Covey of the Covey Motor Car Co., Mr. C. L. Wernicke of the Westinghouse Co., Mr. J. A. Cranston of the General Electric Co., Mr. R. B. Daggett of the Electric Storage Battery Co., Portland Railway, Light & Power Co., Electric Auto Co.

It was the opinion of the meeting that those interested in the electric vehicle business in the Northwest territory should join the Pacific Coast Electric Vehicle Association as a branch. Great enthusiasm was aroused and it is hoped and expected that the electric vehicle business will receive a great impetus.

On the evening of April 26th the electric vehicle people of Seattle and Tacoma met at the Olympus Cafe in Seattle where the meeting at Portland was duplicated. Seattle has in operation about 75 electric vehicles and Tacoma about 12. Judging from the interest taken and the enthusiasm of those present at this meeting, the outlook for the electric vehicle business in Seattle and Tacoma is very bright.

The views of the representatives at the Seattle and Tacoma meeting coincided with those at the Portland meeting in that the Northwest people should all became associated with the Pacific Coast Electric Vehicle Association and that their interests should be looked after by a board of managers to be established later.

Mr. E. A. Boardman was selected as temporary secretary for the Seattle section to assist the officers of the association in carrying on the work, and also to arrange for cooperation with the Northwest Electric Light Association at its next convention, which will be held in Seattle on the 6th, 7th and 8th of September. The Pacific Coast Electric Vehicle Association was invited to present a paper at that time and this invitation will be accepted.

Those present at this meeting were as follows: A. C. Downing, Studebaker Bros. Co.; Louis P. Zimmerman, Elec. Trans. Co.; Thos. F. Jack, Westinghouse Electric Co.; H. B. Dunn, Seattle & Tacoma Power Co.; H. S. Manning, The Seattle Electric Co.; A. F. Boardman, Couple Gear Truck

Co.; C. R. Hooper, Couple Gear Truck Co.; H. H. Alcock, Studebaker Bros. Co., N. W.; R. B. Daggett, Electric Storage Battery Co., San Francisco; F. A. Wing, Broadway Auto Co.; W. J. Grambs, Seattle Electric Co.; C. J. Zintheo, Electric Transportation Co.; F. V. Denton, Seattle Electric Co.; A. S. Moody, General Electric Co.; R. M. Arms, Seattle Electric Co.; N. A. Brown, Tacoma, Wash., No. 813 Division ave.; C. S. Mantell, Studebaker Bros. Co., N. W.; P. F. Sands, Studebaker Bros. Co., N. W.; T. M. Kollock Jr., Westinghouse Electric & Manufacturing Co.

Indications point to the opening of an exclusive electric garage in Tacoma and one or two in Seattle in the near future.

The electric vehicle business in Spokane is in its infancy. The officials of the Washington Water Power Company, however, have shown considerable interest in this business and will make an effort to bring the advantages of the electric vehicle before the people of Spokane in the very near future. It is probable that an exclusive electric garage will also be established in Spokane soon.

ELECTRIC AUTOS IN ROCHESTER, N. Y.

In opposition to the listless attitude of companies in many cities, the Rochester Railway and Light Company has adopted a policy of vigorous promotion of the electric automobile.

It installs a separate clock meter in public and private garages and gives a four cent rate on current used for battery charging between the hours of 9 p. m. and 6:30 a. m. It maintains a department for the inspection of batteries employing a high-salaried expert who periodically inspects all machines free of charge.

The attitude of this company is largely responsible for the fact that in Rochester one sees almost as many electric as gasoline machines and the company derives a nice revenue from this off peak load.—Selling Electricity.

ELECTRICAL EXPERT (Wireless Telegraphy and Telephony)

The United States Civil Service Commission announces an examination on June 9, 1909, to secure eligibles from which to make certification to fill a vacancy in the position of electrical expert (wireless telegraphy), in the Bureau of Equipment, Navy Department, at a salary of $3000 per annum, and vacancies requiring similar qualifications as they may occur.

Competitors will not be assembled for any of the tests.

The duties of the appointee to this position will be as follows: To have charge of the laboratory tests of all instruments and apparatus pertaining to wireless telegraphy; the standardization of circuits and instruments used in wireless; the development of special apparatus and methods of wireless signaling suited to special conditions, and of new forms of sending and receiving circuits; to inspect the various wireless stations and to make the necessary measurements of their electrical constants; to carry on quantative experimentation and original investigation in wireless telegraphy, and, in general, to carry out such work as may be necessary for the development of the science.

The examination will consist of the subjects mentioned below, weighted as indicated:

Subjects.	Weights.
1. General and technical training	10
2. Technical experience	20
3. Special experience in wireless telegraphy and telephony	40
4. Original research and experiments in electrical science with special application to wireless telegraphy and telephony	30
Total	100

Competitors who fail to receive a rating of at least 70 per cent in the third subject will not be eligible for appointment.

Age limit, 21 years or over on the date of the examination.

This examination is open to all citizens of the United States who comply with the requirements.

This announcement contains all information which is communicated to applicants regarding the scope of the examination, the vacancy or vacancies to be filled, and the qualifications required.

Applicants should at once apply to the United States Civil Service Commission, Washington, D. C., for application Form 304 and special form. No application will be accepted unless properly executed and filed, with the material required, with the Commission at Washington prior to the hour of closing business on June 9, 1909. In applying for this examination the exact title as given at the head of this announcement should be used in the application.

NEW BUILDING AT PORTLAND, ORE.

The building of the Portland Railway, Light & Power Company's structure at the northeast corner of Alder and Seventh streets, has reached a stage that begins to show above the line of the sidewalk.

The present three-story building will soon be razed to the ground, leaving only a temporary covering for the big plant of the electric company while the nine-story edifice is being erected.

The building is to be of nine stories. The basement is to be used for cell installation, switches, etc.; the first floor as a substation "A," the main entrance to the building and a store where will be displayed electric appliances, now exhibited on Seventh street in the Calumet Hotel building. The main entrance is to be next the Oregonian building and will lead to the general stairway and two elevators to connect with the upper stories.

The mezzanine story will also contain rooms for the display of electrical appliances and the third floor will be given over to the superintendent of lighting and power and the superintendent of railways, with their assistants and clerical forces.

The fourth floor will be occupied by the accountants and the fifth by the general officers of the company, the president, vice-president and other principal officers. The floors above will be let to tenants for offices.

Work has been started on the wrecking of the building that has occupied the corner for several years. Temporary protection is given to the equipment already installed on the first floor, by substratum of heavy, reinforced concrete. The cost is placed at approximately $250,000, and is to be ready for occupancy January 1, 1910.

PORTLAND SECTION A. I. E. E.

As the result of an energetic campaign there are now nearly fifty members of the American Institute of Electrical Engineers in Portland, Oregon, and they have sanguine hopes that a charter will be granted them to establish a section in that city. Early in January of this year there were but twelve members, but since then thirty-five applications have been filed. Several meetings have been held to discuss papers from the proceedings. On March 16, Mr. L. M. Antoine read a paper on "Automatic Telephony," supplemented by a visit of inspection to the plant of the Home Telephone Company. On April 20th Mr. E. R. Lundius described the fire in the switchboard of the Pacific Telephone & Telegraph Company, and on May 18th Mr. O. P. Guldemeister presented a paper and demonstration on "Wireless Telegraphy."

The executive committee consists of O. B. Coldwell, W. Spaulding, S. Ring, W. M. Hamilton and L. B. Cramer. Mr. Coldwell is chairman and Mr. Cramer secretary.

SEATTLE SECTION A. I. E. E.

Professor C. E. Magnusson of the University of Washington presented a paper on the "Effects of Electrolysis in Reinforced Concrete," May 15, before the Seattle Section of the American Institute of Electrical Engineers.

SIXTH ANNUAL CONVENTION NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

THE California State Association of the National Association of Stationary Engineers will hold its sixth annual convention during the week of June 14th to 19th, inclusive, in the Auditorium, Page and Fillmore streets, San Francisco. In conjunction with the regular annual convention, arrangements have been made to hold a Mechanics' Fair. The main floor of the Auditorium has been subdivided into booths which have been leased to all the great manufacturing firms doing business on the Pacific Coast, and the latter have promised to make this exhibition at least the equal of any ever seen in San Francisco.

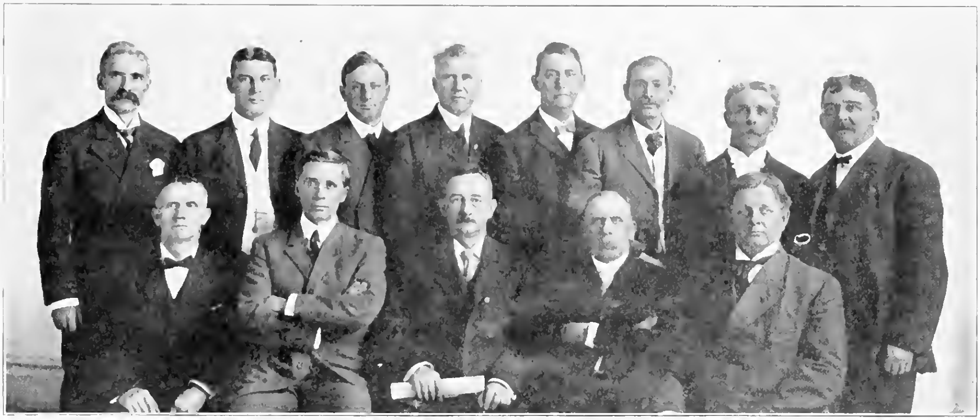
Engineers with their families and friends will be here from the entire Pacific Coast and the committee in charge report everything in readiness to receive them. Prior to 1882 the steam engineers of the United States were disorganized and unknown, but in that year a few engineers led by M. C. Beckerleg of Chicago, met and organized The National Association of Stationary Engineers, and adopted the following preamble which was written by Mr. Beckerleg and has never been changed:

Preamble.

This association shall at no time be used for the furtherance of strikes, or for the purpose of interfering in any way between its members and their employers in regard to wages, recognizing the identity of interests between employer and employee and not recognizing any project or enterprise that will interfere with perfect harmony between them. Neither shall it be used for political or religious purposes. Its meetings shall be devoted to the business of the association, and at all times preference shall be given to the education of engineers, and to securing the enactment of engineers' license laws in order to prevent the destruction of life and property in the generation and transmission of steam as a motive power

The N. A. S. E. stands unique among the industrial organizations of the world as being the only one having such a preamble, and the wisdom of its adoption has been proven by the fact that wherever its provisions have been strictly abided by, success has followed. The California Association No. 1 was instituted in March, 1883, with twelve charter members, only one of whom, Conrad Witzel, is now living. The first meetings were held on the top floor of the Masonic Temple, Montgomery and Post streets, and from this small beginning the organization has grown until at the present time there is a chain of associations located in the various cities from Los Angeles to Vancouver. As the preamble so clearly enunciates the primary and chief purpose of the N. A. S. E. is the education of its members in the details of the profession of steam engineering and so successfully has it fulfilled this mission that many of its members now rank as the most successful and highest paid members of the engineering profession.

The convention committee have adopted the following motto: "Boost for the Engineers, Boost for California, and particularly boost for San Francisco."



JOINT STATE CONVENTION COMMITTEE OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS

Upper Row, left to right B. E. George, H. W. Noethig, M. W. Herzog, John Traynor, John W. Carter, J. L. Davis, W. T. Bonney, Wm. Jenkins.
Lower Row, left to right J. E. Green, Secretary A. C. Arbuckle, President P. L. Ennor, Treasurer Charles Dick, Business Manager E. D. Brewer.

San Francisco No. 1, N. A. S. E., at its meeting of Thursday, May 13th, listened to an extensive report from the State Convention Committee of Arrangements, which showed very encouraging progress.

The committe on securing a meeting hall reported in favor of the rental of Carpenters' Hall, on Fulton street and the association voted to accept that proposition. The first meeting in June will be held in the new quarters.

June 10th was set as the date for a "smoker" and housewarming, and also as a birthday party to Brother Conrad Witzel, the only surviving charter member of No. 1 of California. Refreshments and entertainment will be provided.

Discussion as to the proper amount and placing of air openings in grate surface for oil burning was introduced by Brother Bonney and various members talked on the subject, developing some valuable information. Brother Chas. Bankey illustrated on the blackboard the setting and burner arrangement which proved most successful in an extended experience, and experiment when designing a system of furnace control for oil burners in his plant before the fire.

OBITUARY.

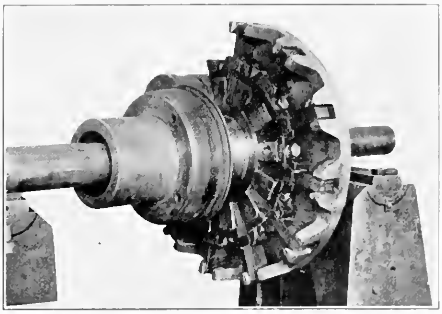
We regret to record the death of Ira Watts, who died of Bright's disease, on April 15th, at Spokane Falls, Wash. He was 49 years of age, and was born in Malden, Mass. About three years ago he removed to Spokane Falls, where he was engaged as consulting engineer. Mr. Watts was for 12 years secretary-treasurer of the Life and Accident Department of the N. A. S. E. and a member of James Watt No. 7 of the same organization. He also instituted an association of this order at Spokane Falls.

INDUSTRIAL

A NOVEL ELECTRIC LOCOMOTIVE.

The accompanying photographs illustrate a novel type of electric locomotive which has been designed jointly by the General Electric and American Locomotive Companies for trying out a scheme of transmitting power from the motors to the drivers through siderods instead of by the ordinary methods.

The locomotive is designed for a tractive effort of 30,000 pounds, at a speed of 18 miles per hour, with a maximum



Flexible Coupling Partly Assembled.

speed of 50 miles per hour and will operate equally well in either direction. It has been tried out with temporary motors of a somewhat smaller capacity and the tests have demonstrated conclusively that the design is entirely satisfactory in every way. It is proposed to extend the cab over the entire length of the machine when the proper motors are installed on the locomotive. The present cab and guards are only for the temporary protection of the apparatus now installed.

One of the principal advantages found in this type of construction is that a motor of large diameter and small air gap can be used in conjunction with small diameter driving wheels, and at the same time the motor can be spring supported. The motor bearings can be easily designed to maintain the small air gap. Such a form of construction will also secure a marked economy in the construction of the motors as the same horsepower can be obtained in two motors at a less cost and for less weight than in four smaller motors.

The same motor equipment can also be used on locomotives with different diameters of driving wheels. This feature makes possible the interchange of equipment on roads where both freight and passenger locomotives of this type are employed. This type of locomotive is as well adapted for operation with direct current motors as with those of the alternating current type.

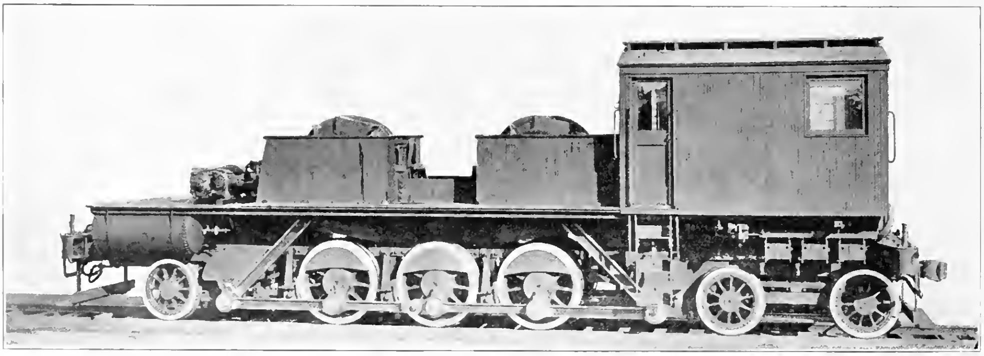
The motors in such a locomotive can be located so as to concentrate a greater proportion of the weight near the center of the machine with the attendant advantage that the moment of inertia of the locomotive around its vertical axis will be as small as possible. This will reduce the rail pressures at the leading and trailing wheels and consequently the flange and rail head wear.

The location of the motors in the cab facilitates inspection and repairs and the renewal of brushes. The maintenance charges for the motors will also be greatly reduced as practically all road dust and other foreign material can be kept out.

The electrical control is arranged in such a manner that the motors start as repulsion motors with short circuited armatures and are changed over to series repulsion motors for the higher speeds. This arrangement eliminates running with a short circuited armature on high voltage and at the same time gives a high torque at starting. In fact the tractive effort is about twice as great with repulsion motor connections as with series repulsion connections for a corresponding current value.

The armatures are similar to those of an ordinary direct current machine with equalizer rings. They have multiple drum windings with the bars soldered directly into the commutator segments.

The field or stationary windings are of the distributed type and are made in two sections—the exciting and the inducing windings. The former has the same function as the field winding in an ordinary series motor, while the inducing winding introduces the working torque when the motor is connected as a repulsion motor.



Experimental Side-Rod Locomotive Equipped With Two 100 h. p. Motors and Temporary Cab.

All parts of the running gear such as wheels, driving boxes, axles, springs, spring rigging, trucks, etc., follow standard steam locomotive practice.

The arrangement of the siderods is shown in the illustration and it will be noticed that each motor is coupled to a jack shaft and thence to the drivers. The jack shaft bearings are rigid in the spring supported locomotive frame and their centers are on a level with those of the drivers.

The object of this jack shaft is to permit a horizontal drive between the spring supported part of the locomotive and the driving wheels and is necessary in order to allow a vertical play of the spring supported part with a negligible variation in the distance between the crank centers.

Counterweights are used on the driving wheels to balance the siderods and it should be noticed that there are no reciprocating parts and therefore a perfect balance can be obtained.

Another interesting mechanical feature is illustrated in the photograph of the flexible coupling inserted between the armature shaft of the motor and the motor crank. This consists of a series of leaf springs arranged radially around the motor shaft and designed of such a strength as to carry the entire torque of the motor flexibly with an amount of deflection which will reduce the effect of the pulsating torque of a single-phase alternating current motor to a minimum.

The more important data is given below:

Trolly voltage	10,000
Cycles	15
Rated tractive effort	33,000 lbs.
Speed at rated amperes	18 m. p. h.
Total horsepower	1600
Number of motors	2
Type of motor	Geaz-43
Diameter of driving wheels	49″
Number of driving wheels	6
Diameter of pony wheels	36″
Diameter of bogie wheels	36″
Total wheel base	33′ 6″
Rigid wheel base	10′
Length, total	43′ 6″
Height	13′ 8″
Weight on drivers	162,000 lbs.
Total weight	250,000 lbs.
Weight per axle, driving	54,000 lbs.

NEW CATALOGUES.

Booklet No. 3779, recently distributed by the General Electric Company, contains a list of this company's snap switches, and will be of interest to the general trade.

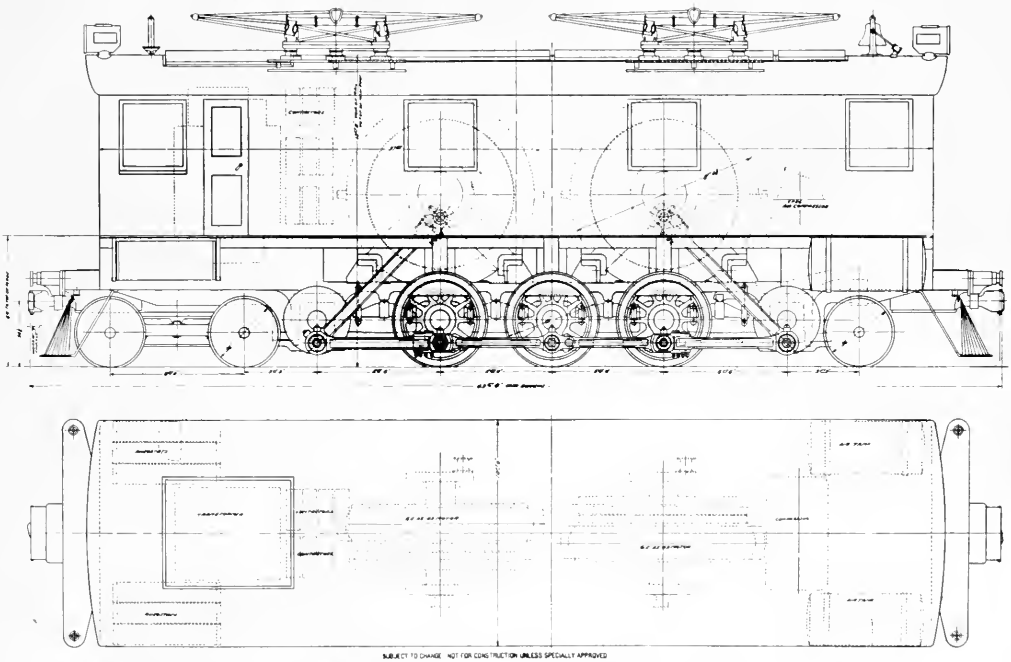
Quite an original method of advertising is being used by the Weston Electrical Instrument Company, of Newark, N. J. It takes the form of a private post card, containing a series of school talks on Weston instruments.

Pass & Seymour, Inc., Solvay, New York, have just issued in a very complete and handy form, Price List No. 174, covering their well known line of P. & S. electrical specialties. It will be mailed to those interested on request.

The Western Electric Company of San Francisco, Seattle and Los Angeles, will have ready for distribution at an early date a catalog of nearly 400 pages on its electric railway and mine supplies. It will be published in sections so that it can be distributed either in parts or as a complete publication.

The Holophane Company has issued under date of May 21st new Bulletin No. 21-A covering new discounts applying to Holophane Globes and Reflectors, Holophane-D'Olier Steel Appliances and other fittings. These bulletins will be supplied on request through their San Francisco office, 151-153 New Montgomery Street.

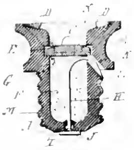
The Westinghouse Electric and Manufacturing Company has just issued Circular No. 1163 on the subject of Type DA Small Motors. It treats of the use of small motors in the home and in business and offers numerous suggestions for their use where both economy and convenience are sought. It includes also some very interesting data and general information relative to this particular line of apparatus.



Side Elevation and Plan of Side-Rod Locomotive as Equipped With Two 800 h. p. Motors and Cab.

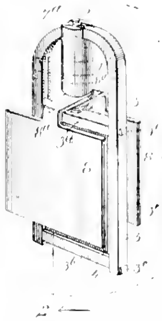
PATENTS

919,744. Electric-Fuse Case. Thomas E. Murray, New York, N. Y. The combination of a tubular case closed at one end and having apertures in its wall near its open end, a fuse in said case, pulverized non-combustible material in



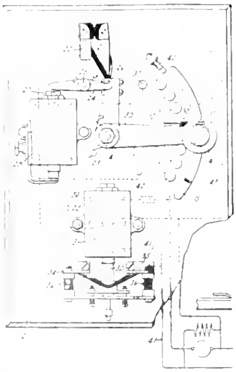
said case and embedding said fuse, a disk of hard noncombustible material within and closing the bore of said case below said wall apertures and bearing upon said pulverized material, and means within said bore for locking said disk therein.

919,900. Primary Electric Battery. George A. Lutz, Plainfield, N. J. A primary electric battery comprising a cover, a supporting rod depending from the cover, an insulating block supported by the rod below the cover, a frame



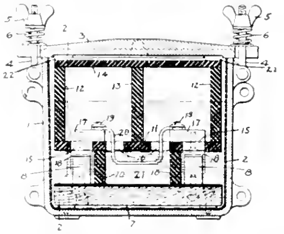
supported by the block and carrying a depolarizing plate, and a positive electrode supported by and insulated from the said rod.

919,998. Starting-Rheostat. Paul H. Zimmer, Schenectady, N. Y., assignor to General Electric Company. A starting rheostat comprising a resistance varying arm, a plurality of independently actuated switches in series therewith, means



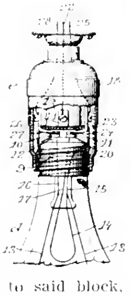
[illegible] ...che ... are closed by an initial movement of said arm, and a normally open circuit closing device in connection with said arm for controlling one of said switches.

919,563. Submerged Fuse. Charles E. Eveleth, Schenectady, N. Y., assignor to General Electric Company. A fuse submerged in liquid, and means for causing the gases produced by the blowing of the fuse to force the liquid to stream past the fuse ends. The combination with a tank, liquid therein,



a submerged baffle plate having holes, fuse terminals on one side of said plate, and a fuse located mainly on the other side of said plate and having its ends passed through said holes and attached to said terminals.

919,821. Incandescent Electric Light. Walter J. Carpenter and Thomas F. McDermott, Providence, R. I. In an incandescent electric light, a bulb having a screw threaded shell, an insulating cap on said shell, a pair of oppositely arranged spaced contact plates on the outer end face of said cap, a high and a low power filament in said bulb, a wire connecting one end of the high power and one end of the low power filament with a point on one side of said shell at a distance from said cap, a second wire connected to the other end of the high power filament extending through said shell and secured to one of said contact plates, a third wire connected to the other end of the low power filament extending through said shell and secured to the other of said contact plates, a socket composed of a shell, a central insulating block secured to said shell, said insulating block being of solid construction and having plain bounding sides, a screw



threaded shell secured to said block, a contact member secured to said block at one side thereof adjacent to said last named shell, a pair of oppositely arranged L-shaped spring contact arms secured to the block sides on opposite sides of said contact member and having their free ends extending on the under face of the block and passed through openings provided therefor in the socket shell, the free ends of said spring contact arms being spaced apart a distance approximately equal to the distance between said pair of contact plates and being adapted to seat on the outer faces of the latter, a pair of wires disposed on the outer sides of said insulating block and connected to said arms, and a third wire disposed on the outer face of said block between said pair of wires and connected to said contact member, all of said wires being disposed on the interior of said socket shell.

NEWS NOTES

FINANCIAL.

SPOKANE, WASH.—The Missoula Street Railway Company has been organized with a capital stock of $100,000. The principal office is at Spokane. A. H. Werthy, of Butte, Mont., is interested.

SAN FRANCISCO, CAL.—A special election will be held in this city on June 24th, 1909, to vote on the $2,000,000 bond issue proposed by the Board of Supervisors last week for the reconstruction of the Geary street road.

ONTARIO, CAL.—The Ontario & San Antonio Heights Electric Railroad Company has secured right-of-way and will construct a line between Uplands and Claremont, Cal., a distance of six miles. The cost of the road will be about $150,000.

WASHINGTON, D. C.—The Mercantile Trust Company of St. Louis offered the highest bid for the $1,000,000 bond issue for the construction of the City of Manila water system. The price offered was $1,022.80 for each $1,000 bond of the proposed issue.

SPOKANE, WASH.—French investors have purchased a $3,000,000 bond issue of a company which is to build an electric line seventy-five miles long in the State of Washington. The company is known as the Okanogan Electric Railway, and Albert M. Dewey of Spokane is its president. Ultimate plans call for extensions of the line which will make a system 500 miles in length.

SAN FRANCISCO, CAL.—The March report of the San Francisco, Oakland & San Jose Railway Company shows an increase of $500 in gross earnings over March, 1908, and an increase of $4,000 in net earnings. The gross earnings of the Oakland Traction Consolidated show an increase of $1,500 over March, 1908, but the net earnings have fallen off $6,000, owing to increased operating expenses, caused by the opening of new lines in Berkeley. The Oakland Traction Consolidated has announced a reduction of the fare between Oakland and Vernon station, on its California Railway branch, from 10 to 5 cents.

SAN FRANCISCO, CAL.—Details in regard to the proposed new financing by the United Railways Ivestment Company are outlined in a letter to stockholders signed by Ernst Thalman, president. A special meeting was held in Jersey City on May 17 for the purpose of ratifying and approving a contract entered into by the company with the protective committee of the Stanislaus Power Development Company. It is proposed to increase the capital stock by $10,000,000. All of the new stock will be preferred. A block of $10,000,000 of United Railroads of San Francisco common stock held in the treasury will be sold and the properties of the Stanislaus Power Developing Company acquired. A new company, to be known as the San Francisco Electric Railways, will be formed and will be controlled by the United Railways Investment Company.

INCORPORATIONS.

SAN FRANCISCO, CAL.—The Quincy Valley Water Users' Association has been formed here by J. Omeara, P. S. Anthony, D. McEwen and others.

TONOPAH, NEV.—The Springdale Water & Power Company has been incorporated here with a capital stock of $250,000 by Morris and Charles Newton.

LOS ANGELES, CAL.—The Kern Star Oil Company has been incorporated in this city by Greeley King, Francis Smitheram, F. W. Mattern and others.

EL PASO, TEX.—The Alpine Power Company has been incorporated here with a capital stock of $35,000 by R. B. Slight, H. W. Townsend and I. H. Derrick.

SAN FRANCISCO, CAL.—The White Light Oil Company has been incorporated here with a capital stock of $10,000 by L. L. Dumme, C. P. Fonda and E. R. Sullivan.

BAKERSFIELD, CAL.—The Sunset Acme Oil Company has been incorporated here with a capital stock of $200,000 by H. W. Thomas, T. M. Young and H. E. Wright.

SALT LAKE CITY, UTAH.—The Borkman Electric Company has been incorporated here with a capital stock of $25,000 by G. Borkman, P. C. Dykes and J. H. Parkes.

SAN FRANCISCO, CAL.—The Southfield Oil Company has been incorporated here with a capital stock of $500,000 by R. H. Smith, R. R. Yates, S. E. Liddle, J. K. Lynch and W. H. Humphrey.

FRESNO, CAL.—The Coalinga National Petroleum Company has been incorporated here with a capital stock of $500,000 by A. S. Cleary, G. V. Martin, F. A. Curtin, A. S. Bacon and S. R. Bosen.

LOS ANGELES, CAL.—The Westside Electric Company has been incorporated here with a capital stock of $75,000 by C. W. Anderson, R. C. Shippee, J. F. Stratton, Jacob Feiber and F. V. Gordon.

BAKERSFIELD, CAL.—The M. P. Oil Company has been incorporated here with a capital stock of $21,000 by W. B. Robb, D. E. Morgan, E. T. Powell, S. W. Marsh, M. P. Flickinger and A. S. Crites.

STOCKTON, CAL.—The Tracy Oil Company has been incorporated here with a capital stock of $500,000 by A. Graunauer, A. H. Linne, H. P. Ludwig, J. W. Brichetto, D. A. Ball, A. G. Ball and others.

OAKLAND, CAL.—The Antelope Valley Oil Company has been incorporated in this city with a capital stock of $75,000 by W. G. Hellinger, D. F. Tillman, J. G. and M. R. Mecham and M. F. Johnstone.

LOS ANGELES, CAL.—The Arrowhead Springs Water Company has been incorporated here with a capital stock of $50,000 by Dr. F. J. Nutting, R. E. Pierce, James Mumford, J. R. Haddock and C. H. Temple.

LOS ANGELES, CAL.—The Surf Light & Power Company has been incorporated here with a capital stock of $1,000,000 by C. W. Hicks, Charles Kratz, J. L. Haley, J. L. Kroeger, J. H. Maurice and others.

TRANSPORTATION.

SAN DIEGO, CAL.—E. W. Peterson has applied for an electric railway franchise on the public highways in the County of San Diego.

VENTURA, CAL.—F. M. Packard and Julian P. Jones have been granted an electric railway franchise on highways in Ventura County.

VACAVILLE, CAL.—Attorney T. C. Gregory, representing the Vallejo & Northern Electric Company, has applied for an electric railway franchise in this city.

OAKLAND, CAL.—The San Francisco, Oakland & San Jose Railway Company has been granted a franchise to operate an electric railway on Hopkins street in this city.

SAN RAFAEL, CAL.—Electric engineers and surveyors have been at work this week on a new electric road which will be built between Sausalito, San Rafael and Petaluma.

SAN FRANCISCO, CAL.—General Manager Black of the United Railroads announces that the company now has in use 12 of the 25 new cars which were ordered some time ago.

STOCKTON, CAL.—H. P. O'Dougherty, formerly manager of the San Jose & Santa Clara Railway Company, has been appointed manager of the Central California Traction Company.

FAIRFIELD, CAL.—The Randall, Wright & Trowbridge Company has been granted an electric railway francise to construct a line between Benicia, Vallejo and White Sulphur Springs.

MIDDLETOWN, CAL.—H. L. Eldridge, representing the Santa Rosa & Clear Lake Railroad Company, announces that at least five miles of the new electric road will be built within the next ninety days.

OAKLAND, CAL.—President Heron of the San Francisco, Oakland & San Jose Railway Company, announces the extension of the Key Route electric system in this city to upper East Oakland and Northern Fruitvale.

BELLINGHAM, WASH.—J. E. Morrison of Seattle says that the interurban as planned by the Nooksack Valley Traction Company from Bellingham to Blaine, via Ferndale, will be built.

PACIFIC GROVE, CAL.—Following the application of the Monterey & Pacific Grove Street Railway Company, bids will be received by the Board of Supervisors up till June 10th, 1909, for the sale of an electric railway franchise over a four-mile right-of-way between Hotel Del Monte and this city.

SACRAMENTO, CAL.—F. A. Warner, coast representative for the Smith Sierra-Sacramento Railroad Company, left this week for the east to arrange for the shipment of rails, wire, cars, and other necessary material for the construction of the electric road between this city and Lake Tahoe. The road between Orangevale and Sacramento is to be built immediately.

OAKLAND, CAL.—Work has been commenced on the new power plant of the Southern Pacific Company at Fruitvale, where power will be generated for the electric lines that are soon to be installed in Oakland and Alameda. The building will be three stories high, and will have a ground area of 128x228 feet. The structure will be of reinforced concrete to the second story, and brick for the balance of the building. The roof will be of tiling placed directly upon the steel rafters. The floors and wainscoting will be of vitrified tile. The building will be completed within the next ninety days.

ALBANY, ORE.—A new street railway franchise was introduced in the City Council on May 10th, and its probable passage at the next meeting of the Council will end the long-continued franchise war in Albany. The proposed franchise is in favor of A. Welch, who operates the present street railway line here, and will cover a number of leading streets for a period of 40 years. In consideration of receiving this new franchise, Welch will surrender the old perpetual blanket franchise, covering all of Albany's streets, which he purchased from H. Hirschberg, of Independence, and under which he is now operating.

OIL.

COALINGA, CAL.—The Lucile Oil Company has bought U. M. Thomas's interests in this district for $65,000.

COALINGA, CAL.—The Pacific States Oil Company has taken over the property of the Enterprise Oil Company.

LOS ANGELES, CAL.—Bids will be received by the City Council till June 17th, for the sale of a 21-year oil pipe franchise on certain streets in this city.

ILLUMINATION.

SAN LUIS OBISPO, CAL.—The San Luis Gas & Electric Company has a force of men at work laying 18,000 feet of new pipe.

CARLIN, NEV.—The Southern Pacific Company is now engaged in installing an electric lighting system in this place.

COALINGA, CAL.—The Coalinga Gas & Power Company has awarded F. H. Hess of Fresno a contract for erecting a $31,000 gas plant in this city.

SANTA ANA, CAL.—The Santa Ana Irrigation Company has applied for an electric power franchise over certain public highways in this county.

LOS ANGELES, CAL.—The Glendora Light & Power Company has completed arrangements for a two-mile electric light and power extension at a cost of $2,500.

SANTA ROSA, CAL.—The Snow Mountain Water & Power Company has asked for the right to construct 17.58 miles of electric line from Fulton to Guerneville.

HANFORD, CAL.—Manager E. E. Bush of the Hanford Gas & Power Co., states that a contract was let this week to R. D. Wood, of Philadelphia, for supplying an additional gas tank, with a capacity of 100,000 cubic feet.

REDLANDS, CAL.—The final transfer of the gas plant of the Edison Electric Company to the Home Gas Company and the transfer of the electric plant of the Home Gas Company to the Edison Electric Company was completed this week. A force of men is now at work making improvements to the electric systems and connecting the two plants.

NEVADA CITY, CAL.—Dr. A. H. Tickell has filed a claim for 5,000 inches of water in the Middle Yuba river with the Recorder of Nevada County, Cal. He says he will erect a large electric power plant on the stream at a point above the dam used by the Plumbago Mining Company, and will take in all the water in the stream. He intends to build on the Nevada County side of the river a plant which will generate at least 500 horsepower.

SAN FRANCISCO, CAL.—The properties of the Tuolumne Water Power Company and the Stanislaus Electric Power Company were sold at auction last week at John C. Rice of Boston, for $2,200,000. Mr. Rice representing the United Railroads Investment Company of New Jersey, a holding company of the United Railroads. A new company will be organized, the stock of which will be controlled by the United Railways Investment Company.

TELEPHONE AND TELEGRAPH.

VACAVILLE, CAL.—Henry Peters has been granted a telephone franchise on public highways in Silverville and Maine Prairie townships.

SANTA CRUZ, CAL.—Secretary Grunsky of the Rural Telephone Company announces that several new telephone lines are to be installed soon.

SANTA CRUZ, CAL.—The Loma Prieta Lumber Company has been granted the right to construct a telephone line between Swanton and Mile Creek.

BAKERSFIELD, CAL.—Following the application of the Kern Mutual Telephone Company, the Board of Supervisors will receive bids till June 7th, for a telephone franchise over public highways to the West Side oil fields.

SAN FRANCISCO, CAL.—The Board of Harbor Commissioners has fixed a monthly rental of $10 for the rights of the Western Union Telegraph, the Postal Telegraph and the Pacific States Telephone Companies to land their cables on the water front.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer—who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

ADAPTERS

Lamp Adapters
American Eveready Co.
Benjamin Electric Mfg. Co.
Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Perkins Elec. SwtchMfg.Co

ALARMS.

Burglar Alarms
Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc.
Western Electric Co.

Fire Alarms
Edwards & Co.
Partrick,Carter&WilkinsCo.
Western Electric Co.

Water Alarms
Partrick,Carter&WilkinsCo.

ANCHORS

Johns-Manville Co., H. W., "J. W."
Kierulff, B. F. Jr. & Co., "Hubbard."
Klein & Sons, Mathias.

ANNUNCIATORS

Edwards & Co.
Elec. Goods Mfg. Co., "Ross," "Rivol," "Perfect," "Noxall."
Patrick, Carter & Wilkins Co., "King."
Standard Elec. Works, "C. & S."
Stanley & Patterson, Inc.
Telephone & Elec.Equip.Co. "Holtzer-Cabot & Co."
Western Electric Co.

ARMS.

Cross Arms
American Cross Arm Co. "Walworth & Neville."
California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

Mast Arms
Elec. Appliance Co., "Cutter."
Ft. Wayne Electrical Wks
Kierulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher."

Desk Phone Arms
Dean Electric Co
Electric Appliance Co., "Eaco."
Kierulff, B. F., Jr. & Co., "Sterling."

INDEX TO ADVERTISEMENTS

Sterling Elec. Co.
Western Elec. Co.

ASBESTOS

Johns-Manville Co., H. W.

AUTOMOBILE ACCESSORIES

American Eveready Co., "Ever Ready."

BATTERIES

Dry Batteries

American Eveready Co., "Ever Ready" and "Crescent."
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Standard Electric Works, "Standard."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

Dry Battery Holders

Brooks-Follis Elec. Corp.
Stanley & Patterson, Inc., "Patterson."

Medical Batteries

Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Electro - tonic," "Vetter."

Wet Batteries

Brooks-Follis Elec. Corp.
Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

Storage Batteries

Elec. Storage Battery Co.
Westinghouse Machine Co.

BELLS

Electric Bells

Brooks-Follis Elec. Corp.
Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

Electro-Mechanical Gongs

Brooks-Follis Elec. Corp.
Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.

Magneto Bells

Brooks-Follis Elec. Corp.
Dean Electric Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Switchboard & Supply Co.
Standard Electric Works, "C. & S."
Western Electric Co.

BOILERS

Henshaw, Bulkley & Co.
Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, "Edge Moor."

BOXES

Floor and Outlet

Krantz, H., Mfg. Co.

Junction Boxes

Krantz Mfg. Co., H.

Wall Boxes

Brooks-Follis Elec. Corp.
Benjamin Elec. Mfg. Co.
Bossert Electric Construction Co., "Bossert."
Chase Shawmut Co., "Knockout."
Chicago Fuse Wire & Mfg. Co., "Union."

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity Power and Gas *604 Mission Street, San Francisco.*

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.
Journal of Electricity, Power and Gas.
604 Mission Street, San Francisco.

AGENTS WANTED on a guaranteed weekly salary to represent our two publications, "Southern Engineer" and "Southern Machinery"; liberal terms for exclusive services; easy sellers; every engineer and every machinist is interested. Write at once. For further information, address W. R. SMITH PUB. CO., Sub. Dept. Atlanta, Georgia.

WANTED—Men coming in direct touch with Steam, Electrical Superintending Engineers and Shop Foremen. A proposition that can be handled by energetic persons to good advantage. Liberal commission and permanent work. CHAS. L. TURNER, 907 Atlas Bldg., San Francisco, Cal.

SITUATION WANTED—By electrical engineer with 15 years' experience in designing and estimating of electric power plants, switch gears, light, motor and storage battery installations; also in central station service. Advertiser takes also draughting work in this line as home occupation if no steady engagement can be attained. Moderate expectations. Address Box 101, **Journal of Electricity,** San Francisco.

WANTED—Trustworthy man or woman in each county to advertise, receive orders and manage business for New York Mail Order House. $18.00 weekly; position permanent; no investment required. Previous experience not essential to engaging. Spare time valuable. Enclose self-addressed envelope for full particulars. Address Clark Co., Wholesale Dept., 103 Park Avenue, New York.

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H. H. SINCLAIR

— See Page 430

JOURNAL OF ELECTRICITY
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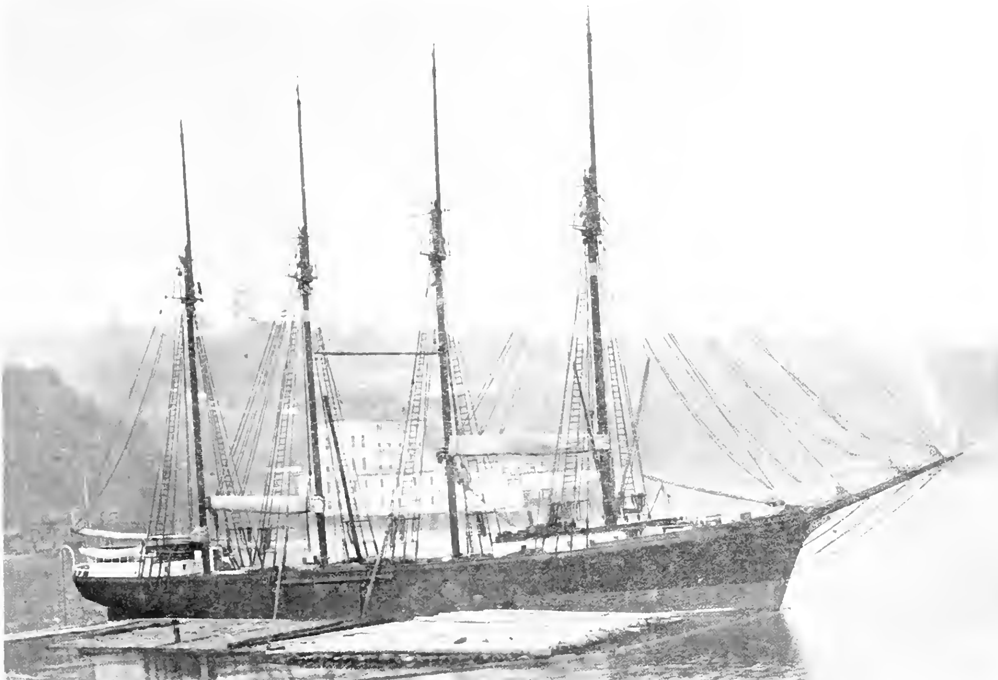
SOMETHING ABOUT THE "TEREDO."

BY C. H. JOHNSON

The work of harvesting and shipping poles for the use of the power, telephone and telegraph companies on the Western Coast is one of the most important industries of the rapidly growing Northwest and this business in recent years has grown to a magnitude that the general public can hardly appreciate.



Vessel Loading With Poles in the Northwest.

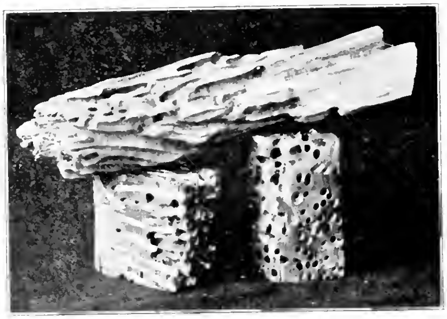
One of the most serious obstacles to be overcome in the handling of the pole business is the "teredo," that little insect, infinitesimal in size, which has been the bane of ship owners and the despair of wharf and ferry companies on the Pacific Coast for years.

The teredo, invisible at the time of its attack, grows rapidly as it works its way into the wood from which it draws its sustenance and its increase in size is easily traced by the constantly enlarging holes bored in the wood as it grows in strength from day to day while engaged in making a veritable honeycomb of a once sound and sturdy piece of timber.

It is a well known fact that the teredo does not exist in fresh water nor can it live when transferred from fresh to salt water, but dies immediately on being submerged in other than the ocean's brine. It is the practice of shippers therefore to store their stock of poles in the fresh water lakes of the Northwest until ready for loading. The handling of poles has been reduced to a science and from the time they leave their homes in the forests of Washington and Oregon on their trip down the river, in their journey to the sea, they are in the hands of experienced and careful men, and guarded against the waiting teredo at the sea shore.

When ready for loading the poles are towed from their storage in fresh water to the ship. This transfer is made in small lots and the stock expeditiously handled in order to limit the period of immersion in salt water to the minimum.

It is only an ordinary pole, but the experienced buyer and construction superintendent knows full well the importance of this care and its relation to the future life of his pole line.



Fragments of Washington Cedar Showing the Work of the "Teredo."

The teredo known to the ancients as the "ship worm" dates from before the time of man; traces have been found among the fossil remains of the Eocene of Great Britain and France and they are mentioned in the writings of Pliny and Ovid.

In 1733 great consternation was caused in Holland owing to the threatened inundation of the country through the destruction of the dykes by teredos.

The teredo, while only an atom at the beginning of his work, rapidly develops until he reaches the length of three feet. He burrows generally, though not always, in the direction of the grain and it is an indisputable fact that one burrow is never found to break into nor cross another; should he accidentally lose his bearings and tap an adjoining burrow he invariably switches back to his own territory and continues on the even tenor of his way. This is an example of "team work" worthy of careful study as showing what can be accomplished by good organization and strict attention to business.

Electric Railways in Norway have been unknown until recently. The first one has just been placed in service. It is nearly 30 miles long and connects Thamshavn and Lokken. The single phase system is used, with catenary line construction and 30-ton locomotive.

THE REAL PURPOSE OF THE AIR BRAKE.[1]

BY W. S. BARTHOLEMEW

PART II.

I have explained to you what we call a "triple valve" and why we call it so. Here is a diagram of a plain triple valve:

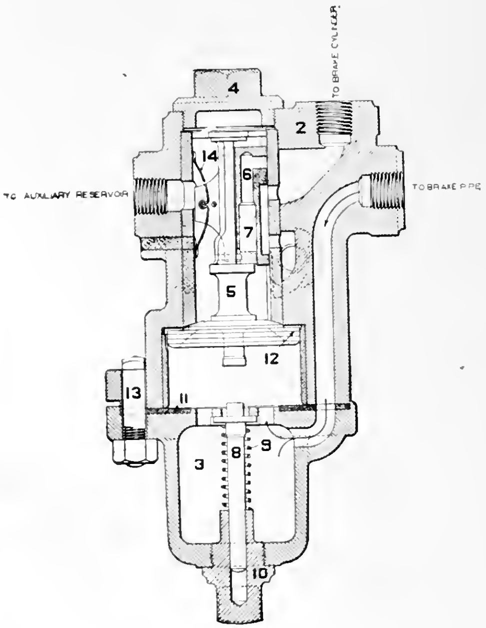


Fig. 3. Plain Triple Valve.

This will give you some idea of the construction of the functional part of the air brake and, to go back some in the talk, what we called the plain automatic brake was that part of the equipment as we have it here. Most people think the air brake is a series of these valves connected directly together by the brake pipe going into one side and out the other, and so on serially through the train. I will not touch on the engine equipment tonight, because, as a matter of fact, the demonstrations this summer were to illustrate the air brake action on the trains back of the locomotive and to cover the features of the locomotive equipment would take considerable time.

So I am going to begin, leaving the engine out of the discussion, and show you that we have first what we call the "brake pipe." The train men call it a "train pipe." The reason we call it a brake pipe is because in passenger trains we have several pipes through the train. In electrically operated trains on which we have electric compressors on the different vehicles, we run a third or perhaps a fourth pipe through the train for other purposes. So we distinguish between the different pipes: A main reservoir pipe, a brake pipe, a control pipe, etc.

Most people have an idea that this pipe goes right through the air brake proper, i. e., that the pipe

[1] Part I of "The Real Purpose of the Air Brake" appeared in our issue of May 22, 1909.

goes through the triple valves, so to speak, but one very important thing I want to point out to you, which has a great deal to do with the air brake art, is the fact that the brake pipe exists through the train and the air brakes on the different vehicles are connected only to laterals on the brake pipe.

Illustration No. 4 shows them very short; but as a matter of fact, they are six or eight or ten feet long, according to the location on the car. I want to point out to you that the development of the air brake art has to do with the serial action from vehicle to vehicle; but things that happen in those laterals and have an effect upon the brake upon the car must affect the conditions of the air pressure in the main pipe. On each vehicle we have a reservoir which we commonly call the "auxiliary reservoir," which carries a volume about two and one-half times the volume which is required by the brake cylinder. The "brake cylinder" is that part of the equipment into which the pressure is admitted which works finally through the movable brake cylinder piston valve piston. What we must first do before we can made a brake application is to get air into the auxiliary reservoir. The only way is by a little port through the slide valve and through a little groove over the top of the triple valve piston, which we call a "feed groove." A change in the size of that groove either larger or smaller would materially affect the application and release of brakes in long trains.

You will be interested to know that that air passes the feed groove at the rate of about one pound per second; that will give you some idea as to how long a time it takes to charge up the auxiliaries preparatory to making a brake application and to secure a return to the pressure we had originally. When time enough has elapsed to get the auxiliary reservoir pressure up to the pressure that the brake pipe pressure is regulated at we are ready to make a brake application. The triple valve piston having been shoved over by the original pressure stays there until the auxiliary reservoir is charged and when we get pressure on both sides of the piston the same, it still

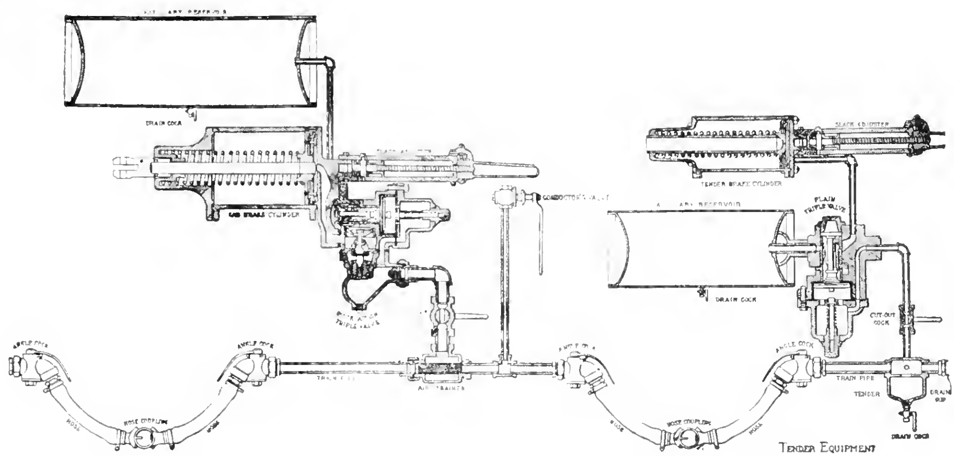


Fig. 4. Showing Brake Pipe and Equipment Connected to Laterals.

and the levers to the shoes on the wheels. That stored volume in the auxiliaries, the condition of it, the time that it takes in making reductions and the time that it takes to restore it, are what have to do with the engineering difficulties, not only in the development of the air brake, but in the use of it.

The important thing in the equipment is the triple valve, and the one shown in Fig. 5 is one of the latest improved type.

It is primarily what we call a "quick action triple valve"; the principal feature of it is a piston to which is connected the slide valve which you all understand controls the ports. The whole trick is to get that piston to move, then to stop it and then return it to its normal position at the will of the man on the engine. That, primarily, is the whole secret.

On the engine we have a "regulating valve," called in our practice, a "feed valve," which supplies the brake pipe against leakage and maintains a certain pressure, say 80 pounds. That pressure then comes up to the front, or brake pipe side, of the triple stays there; then we have 80 pounds on the brake pipe side and 80 pounds on the auxiliary reservoir side, and nothing in the brake cylinder. The auxiliary reservoir being some two and a half times the size that we shall require in the brake cylinder with the brake cylinder piston's longest travel—that is about the way we ordinarily figure it—means that for each pound we let out of the auxiliary we will put approximately two and a half pounds in the brake cylinders. So that when I come to use some of the illustrations in the report and when we say we made a 5-pound application, we do not mean that we put five pounds in the brake cylinder; we mean practically twelve and one-half pounds. We make a 5-pound application by letting five pounds of pressure out of the brake pipe. Then what happens? The piston moves over toward the brake pipe side, which we have let down to 75 pounds. That would mean that we have about 45 pounds force to move that piston over and to take the slide valve with it until the auxiliary reservoir pressure is connected up through a port

which opens up to the brake cylinder. As soon as the auxiliary reservoir is open to the atmospheric pressure in the brake cylinder, the 80 pounds very soon—in fact, almost immediately, goes down to slightly below 75 pounds, which puts about 12½ pounds in the brake cylinder as I have explained; but, as soon as the auxiliary reservoir pressure gets down to 75 pounds, we have then the same pressure on both sides of the triple valve piston, but, instead of the auxiliary reservoir pressure stopping at 75 pounds, it continues reducing as I just said, enough to permit the brake pipe pressure on the other side of the piston to move the piston and valve and close the ports, thus stopping the brake application.

I had another set of charts, but, unfortunately, I had not room to put them up. I had among those charts a diagram showing this piston in the different

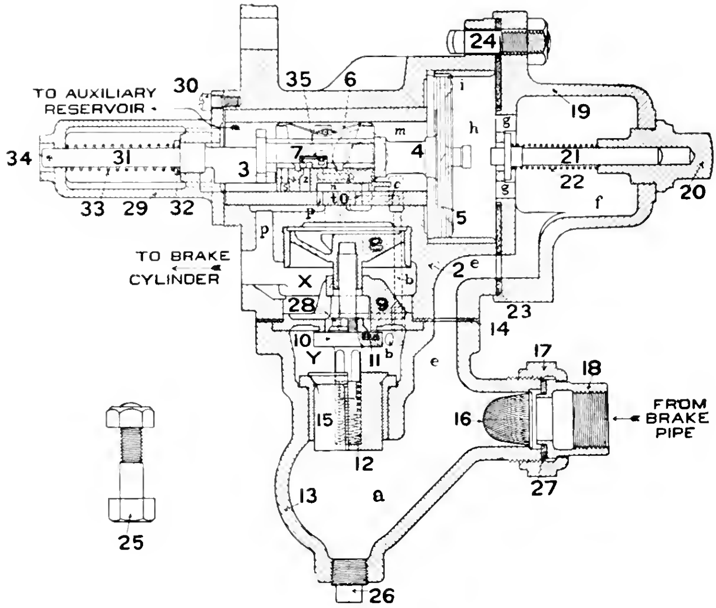


Fig. 5. K-2 Improved Quick Action Triple Valve.

positions that occur through these different movements. I might have mentioned that it takes about one pound and a half differential on the piston area of about nine inches, i. e., about 13 or 14 pounds force to move the piston at all with the pressure on top of the slide valve.

First we want the piston to move, but a much more important thing is in wanting it to stop. If it does not stop in service position, another thing occurs; that is, instead of getting 12½ pounds in the brake cylinder, we would have opened the emergency port and secured about 60 pounds; so that, while it was important to have this piston start to move, the first consideration being to get it to move, the second to get it to stop where we want it to stop, and the third consideration is to get it to stay there. That is what causes a lot of trouble, the fact that it fails to stay in a certain place. The operation described is called a "service application," a light service application, i. e., that it was practically the least use we could make of the brake as far as long freight trains are concerned.

I might tell you right here what the "emergency application" is, because that has to do very largely with one of the epochs of the air brake. I have explained to you that the triple valves are on the vehicles connected to the laterals and they in turn are connected to the brake pipe and on the train that we had this summer the brake pipe was 3,700 feet long. Imagine having 80 lateral connections on a 3,700-foot pipe and the end you are aiming at is to get every one of those triple valves on every one of those laterals to do the same thing at the same time. You engineers know that if we start to let the air out of that pipe on the front end we can let it clear down to zero before we get much of a reduction on the rear end; consequently we could not depend entirely on this opening at the front end. We have to inject a feature into these valves which, when desired, will pick up that serial action, as we call it, that will cause the pistons to go themselves into the position that we want them to go into, and stay where we want them to be put. But, in that little instant of movement from the position where they are at rest to the emergency position, they do a very important thing; they take a little air out of the lateral and consequently out of the brake pipe, which accomplishes two purposes; the first is to reach over to the next vehicle with the little differential, as we call it, thus created, and set the next triple valve piston in motion, and it in turn takes up that serial action and moves the next one, and so on until all the brakes are applied in the shortest possible time.

The second thing accomplished is to put the air into the brake cylinder that is thus taken out of the brake pipe, assisting in building up pressure to force the brake shoes against the wheels, the emergency port from auxiliary reservoir to brake cylinder having been opened by the slide valve in the meantime, permitting about 20 per cent more brake cylinder pressure to be secured than if the brake pipe pressure had been permitted to escape to the atmosphere. That is what is termed an "emergency application" of the brakes.

When the engineer starts to make a 5-pound service reduction it is a long time before that reduction reaches the rear end and here is where one of the improvements that has not been in brakes before comes in, that is, in the triple valve shown in Fig. 5. When we had the 30-car train limit, prior to 1887, there was no arrangement in the valves at all to assist in transmitting serial action, even in emergency. It was just the plain triple valve shown in Fig. 3, and all reduction to make these triples act, no matter how long the train was, was by the discharge of brake pipe pressure to the atmosphere of the brake valve.

You all know of the great fortune that has been made out of the air brake on the fundamental patents. The feature of transmitting serial action in the manner described is the fundamental Westinghouse principle, which has never been gainsaid throughout the entire life of the patents; that is, an arrangement of operating parts and ports in the triple valve which, when an immediate reduction was made out of the brake pipe at the head end of the train, the piston would come over so far that it would set a new set of parts into action and open up a connection to the lateral and thence to the brake pipe and the brake pipe pressure would be applied to the brake cylinder piston. Two things thus happened, as above described. That was the fundamental Westinghouse patent of taking air out of the brake pipe to create serial action through the train and putting it into the brake cylinder and not discharging it to the atmosphere. Other brakes were afterward invented, and one is being marketed to some extent in which, instead of putting the brake pipe air into the cylinder, they discharge it to the atmosphere. That practically was the way they attempted to get around the Westinghouse patent; but, about that time the fundamental patent expired, i. e., the part of the patent that procured that impulse through the train in emergency applications, had expired.

The operating parts of the triple valves which transmit the serial action as described are called the "quick action" parts and were added to the triple valve about the year 1887.

The need for the improvement was illustrated in the extensive series of demonstrations called the "Burlington brake trials," very similar to the demonstrations made in California this summer and for practically the same purpose, i. e., to illustrate the long time that it took between the application of the brakes on the front end and the application of the brakes at the rear end with the old method of letting the air out of the brake pipe at the head end only, the difference, however, being that the "Burlington brake trials" were confined practically to the use of the brakes in emergency, whereas, the Southern Pacific demonstrations this summer were confined to illustrating the improvements in the triple valves for use in the ordinary requirements, i. e., uses for controlling the trains in daily service.

Trains have developed from the 50-car trains of that day to 80 and 100-car trains today. So we now find it necessary to inject a serial action hastening device in the triple valve to secure an improvement in the serial action in what we call the "service" use of the brakes, that is, not in emergency. When an emergency application became necessary with the original plain automatic brake it took about half a minute to get the brakes applied on the rear end. With the quick action automatic brake which Mr. Westinghouse invented immediately after the Burlington brake trials, it takes about $4\frac{1}{2}$ seconds; and

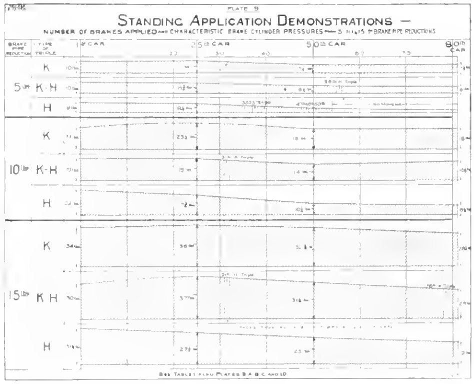


Plate 9.

all we have attempted to do with any of these improvements is to apply the brakes faster than the slack can run in.

Mr. Babcock: Will you not explain the reason for that, why the slack makes the damage?

Mr. Bartholomew: I think I can do that better by having you turn to the report.

Mr. Babcock: I mean the mechanical reason for it, the action of checking the head of the train.

Mr. Bartholomew: If you will turn to page 29 of the book that you have in your hand, you will see some very good reasons for it. This does not exactly represent the old emergency action, but, if you will look on Plate 9, there are shown some diagrams which represent the condition of the pressure in the brake cylinders through the train at the completion of the applications.

These diagrams show only the pressure; I will show you the time afterward; but this is after the pressures are the fullest from any given brake application. The first three diagrams on the top of the page illustrate three different 5-pound applications with different mixtures of equipment, these 5-pound applications being made, as I have explained, by taking 5 pounds out of the brake pipe and, in turn, 5 pounds out of the auxiliary reservoirs, and securing the pressures in the brake cylinders through the trains, as indicated. We have lettered these for convenience, KK and HH. Look at the third line, in

which you will find with the H triple valve we have nine pounds on the first car. The records in this particular demonstration were taken with the train at rest, and at four places on the train. We know, by making tests, that these points from which we have drawn the lines from point to point represent the average conditions. We have nine pounds in the first car, 8¼ in the twenty-fifth. But, before we got to the fortieth car, the brakes began to skip, as on the thirty-fifth, thirty-seventh, thirty-ninth, forty-seventh, forty-eighth, fiftieth and after about the fifty-third car—perhaps fifty-fourth—we did not get anything. You can readily see what happened. This will represent a similar action to the emergency action in the old plain triple. When we got the brakes on at the front end, if the train was going at the rate of 30 miles per hour, we would get a retardation on the front end so much quicker than at the other end that there was a great force developed through the slack running in.

You can now appreciate when trains got so long that what we call the service application failed to go through the train even with all brakes cut in, we knew it failed long before any one else knew it, and it was necessary to set about devising improvements so that the brakes would run the serial action completely through the train with light applications and quicker than before.

Remembering the five conditions mentioned earlier in the evening, which made it seem advisable to avoid changing the equipment on the cars in any way, and, if possible, bring about the improvement by making the changes in the locomotive equipment, we attempted to hurry up the service applications by letting the air out of the brake pipe faster on the engine than formerly, and every possible scheme was tried along these lines to bring about the desired result, but without success, and it became necessary, therefore, to add improvements to the triple valves on the vehicles through the trains to accomplish the desired purpose.

The improvement which insures the serial action of the brakes running completely through the train and in shorter time than formerly we have called the "quick service" feature, which hastens the time of serial action of the brakes through the trains in service applications in a similar way to hastening the time of serial action in emergency, as I have explained to you, except in a lesser degree, the emergency action remaining the same as before, the service time, however, being practically cut in two and running completely through the train.

This result is brought about by each improved triple valve, which we call style "K," making a local reduction of brake pipe pressure on each vehicle by taking a quantity of air out of the brake pipe and admitting same to the brake cylinder similar to the emergency action which I have explained, this small local reduction thus made setting the triple valve in action on the next adjoining vehicle, this latter action resulting, also whether the next triple be of the improved or any other type. The brake pipe air thus placed in the brake cylinder being equal approximately to the displacement of the brake cylinder piston during this movement, thus permits the air then admitted from the auxiliary reservoir to build up pressure immediately, making a much more prompt application of the brakes on the vehicles in addition to the shorter time of serial action through the train.

This local reduction produced by the quick service feature results in complete serial action of the brakes through trains of any length with only very light brake pipe reductions on the head end and secures the effective use of the brakes uniformly on all vehicles instead of building up heavy braking efforts on the head vehicles in attempting to get the brakes to apply on the rear end of the train, as heretofore.

The first thing we are after is to get all of the brakes in the train to operate. The second is to get them to operate faster than the slack can run in, and the third is to get uniform braking efforts throughout the train. Plate 9, as shown, graphically illustrates the results of different brake applications as represented by the brake cylinder pressures throughout the train at the end of the applications. When it is remembered that the "K" triple valves operate throughout the train in less than one-half the time serially of the old style "H" valves, the diagrams shown are unusually significant. The first three diagrams show the lightest possible service application with all improved triples, then half improved and half old style, and then with all old style, and it will be noted that all of the brakes in the 80-car train operated with the light application with the "K" triple valves and that there was very uniform final pressure in all of the cylinders. The diagrams shown of half new and half old illustrate similar uniform results, which is brought out by the fact that each improved "K" triple valve favorably affected the old style valves on the adjacent vehicles, the equipment being distributed throughout the train alternately. The third diagram illustrates what I have been describing to you as the loss of serial action back in the train, the first brake failing to apply in this particular demonstration being the thirty-fifth, and then skipping miscellaneously to the fifty-third and then none applying back of that. The sixth and ninth diagrams represent the unequal braking efforts which resulted from attempting to get the brakes to apply on the rear end of long trains with old style triple valves.

In the sixth diagram will be noted a difference of 13½ pounds brake cylinder pressure between the front and rear end of train in marked contrast to one pound difference between the front and rear end, as shown in the fourth diagram of a similar application with all improved triple valves. The comparisons shown on Plate 9 are of still further interest, when taken into consideration with the time comparisons shown on Plate 2, from which it will be seen that the eightieth brake applied in 13 seconds with the "K" triple valves and in 27.7 seconds with the old style "H" triple valves in the applications from which diagrams 4, 5 and 6 on Plate 9 were made. I have stated before that we have attempted to cut the time of serial action in two and the comparative time shown on Plate 2, being 13 seconds for the eightieth car with "K," as compared with 27.7 seconds with old style of triple valves, illustrates our claim that this has been accomplished. This improvement in time of serial action which we consider is now faster

than the slack can run in through long trains, will probably serve until the entire elimination of time of serial action can be accomplished through electrically operated equipment, which, of course, for a long time to come, will practically be impossible, as far as freight cars are concerned.

The operating results of securing brake applications through the train with light brake pipe reductions, as illustrated on first, second and third diagrams on Plate 9, are shown on Plate 13.

The trains having the different triple valve equipment were accelerated to different speeds in miles per hour shown on the plate and stops made with the

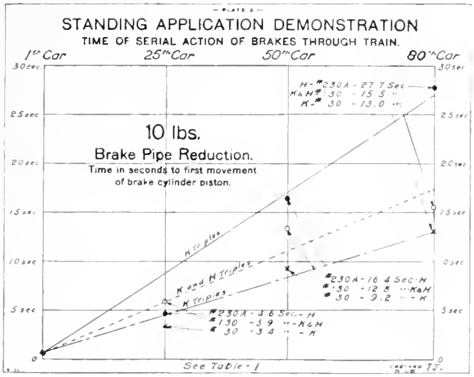


Plate 2.

5-pound brake pipe reductions and the comparisons of stops from 30 miles per hour is what might be expected from the areas of the first three diagrams shown on Plate 9, as the loss of serial action in the train as illustrated on the third diagram permitted the train to run 4,138 feet after the brake application

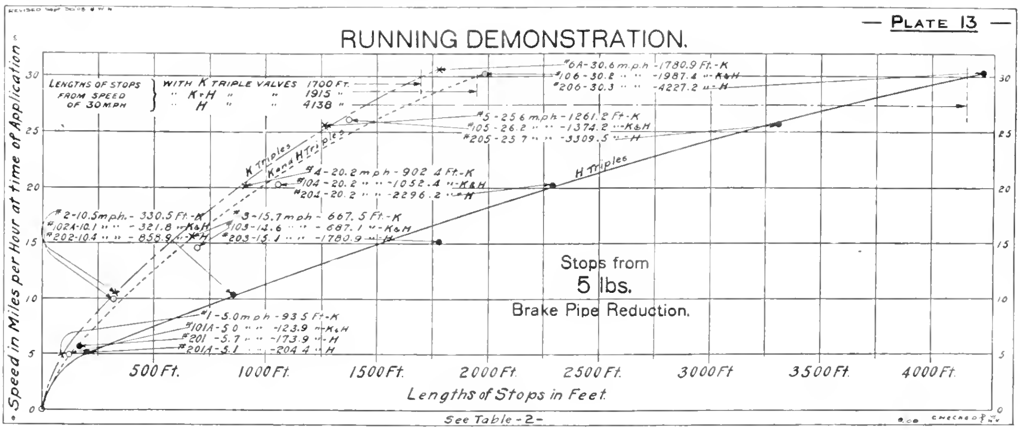


Plate 13.

was made, in marked contrast to the stop in 1,700 feet by securing an effective use of all brakes in the train, as illustrated by the first diagram on Plate 9.

The first question Mr. Kruttschnitt asked me when explaining the results of the demonstration to him was: "How will the new equipment work with the old?" and by referring to the middle diagram on Plate 13, showing the stops from the different speeds with half new and half old style triple valves, it will be seen that the results were similar to those with all improved triple valves, and this accounted for by the fact that each new triple valve favorably affected the equipment on the neighboring vehicles, as I have before explained to you, thus living up to the fourth limitation mentioned earlier in the evening, that any improvement injected into air brake equipment must improve the old equipment with which it must operate through the transition period. The results of these demonstrations, as illustrated on the diagrams, show that the improvement to the old equipment on adjacent vehicles made an increase of about 50 per cent in their efficiency.

Mr. Babcock: How were the different types of equipment distributed throughout the train?

Mr. Bartholomew: Alternately. You will also be interested to know that in another demonstration we put them in blocks of five; in still another demonstration in blocks of ten; and that the time of serial action did not vary two seconds, the stops were made in about the same distances as shown on Plate 13. We made them alternately in this case for a purpose. We wanted to show that the new triples would improve the old ones on the intermediate vehicles so that the train control would be almost as good with half and half as with all new, as illustrated by the middle curve on Plate 13.

One of the benefits of the improved time of serial action and uniform distribution of braking effort through the train with service applications is not really shown in any of the diagrams in the air brake report, but, to make a record of the reduction of the shocks internally in the train by the application of the brakes faster than the slack would run in, we had the dynamometer car in the train placed usually in the middle, which would record blows incident to slack running in and jerks from the slack running out, and all of the observers were impressed with the improvement shown with the "K" triple valves.

Mr. Babcock: What does that do, the slack running in?

Mr. Bartholomew: There is a total of about seven inches of slack in every car. That in an 80-car train is quite a good many feet. The cars have that for free movement before the draft rigging is up solid, and that free movement, of course, if it is unhindered, is going to permit the cars to run in, compressing the draft rigging until all are up solid, which makes a considerable distance for the cars in the rear of train to run before being checked by the head cars. The cars, thus running free for a certain distance, cause a blow and that blow is what shoves the lumber through the ends of box cars and otherwise damages equipment and lading. The purpose of all of these demonstrations, as far as freight trains are concerned, was to show the different benefits coming from this improved time of serial action which has been explained to you—perhaps not as plainly as I should like.

(Part III, completing Mr. Bartholomew's article on "The Real Purpose of the Air Brake," will appear in our issue of June 5th.)

TEST ON GROWING OF EASTERN HARDWOODS IN CALIFORNIA.

The Pacific Coast will soon be the scene of an interesting tree growing experiment. The United States Forest Service is planning to introduce a number of the more important Eastern hardwoods into California, and will this year experiment with chestnut, hickory, basswood, red oak and yellow poplar or tulip trees. Small patches of these trees will be planted near the forest rangers' cabins on the National Forests, and if these do well larger plantations on a commercial scale will soon be established on wider areas.

There are over 125 different species of trees in California, a number of which produce some of the most valuable varieties of lumber in the country. Although considerably over one-half of the species are hardwood or broad-leaved trees yet, with the exception of the exotic eucalyptus, there is not a single species of hardwood here ranking in commercial importance with the leading Eastern hardwoods. Climatic conditions in many parts of California are undoubtedly favorable for the growth of a number of the valuable hardwoods, and the absence of these trees is due mostly to unfavorable factors of seed distribution.

If the experiments are successful, a valuable asset will have been added to the forest resources of this State, which should prove of special benefit to the local furniture and vehicle industries. Chestnut and red oak are highly esteemed for furniture, while with hickory, basswood, and eucalyptus at its command, California should lead all other States in the vehicle industry.

The electric conducting capacity of fire streams is a subject of general interest, so it may not be amiss to call attention to some comparatively recent experiments made by the Pennsylvania Railroad Company, which have shown that there is no danger of the current flowing down a stream of water even from a high-voltage line when the operator holds the nozzle at a distance of between three and four feet from the wire.

H. H. SINCLAIR, VICE PRESIDENT AND GENERAL MANAGER OF THE GREAT WESTERN POWER COMPANY.

H. H. Sinclair came to Southern California from New York City, July, 1887, and settled in Redlands, San Bernardino County.

In 1892 he helped organize and was made President and General Manager of Redlands Electric Light & Power Company, being personally in charge of all its construction work.

In 1892-93 said company installed and put in operation the first triphase power transmission plant in the United States—the second in the world—there being an experimental plant installed at Tivoli, near Rome, Italy. The Redlands plant has been in constant commercial use since its installation and the company has now on its system the first triphase generator, the first triphase synchronous motor and the first triphase induction motor ever put out by the General Electric Company.

In 1896 Mr. Sinclair began work on the plant of the Southern California Power Company, of which company he was President and General Manager.

This plant was designed for the transmission of 5000 k. w., 80 miles at 33,000 volts, and was a long step in advance of any transmission work then in existence or contemplation. At that time the longest distance was 45 miles and the highest voltage 15,000 volts. The many doubts expressed concerning the feasibility of this scheme and the absolute refusal of prominent engineers to endorse it make interesting history in view of its subsequent success. Mr. O. H. Ensign, now Chief Electrical Engineer of the United States Reclamation Service, was the electrical engineer on this plant, and to his judgment, indomitable energy, and great resourcefulness, a large amount of credit is due for the successful operation of the plant.

The next large work undertaken by Mr. Sinclair was the development of power on the Kern river in 1901, by the California Power Company, of which he was President and General Manager. This company, as also the two corporations above mentioned, were finally merged in the Edison Electric Company of Los Angeles, of which Mr. Sinclair is now Vice-President.

The Edison Electric Company under the active supervisions of Mr. Sinclair has installed on its system in addition to the pioneer equipment previously mentioned, the first oil break switches, the first revolving field generators, the first 12,000 volt generators, the first high potential measuring instruments, the first steel towers and the first steam turbines that ever came west of Chicago.

After completion of the Edison Company's 20,000 k. w. plant on Kern river in August, 1907, Mr. Sinclair gave up active business for a year, and in October, 1908, opened an office in Los Angeles for the examination of hydro-electric projects. Being a large stockholder of the Edison Electric Company, it is expected that he will still retain his position as a Vice-President and Director of that company. He will assume charge of the affairs of the Great Western Power Company on June 1st, with the position of Vice-President and General Manager.

CURRENT COMMENT

Motor Cars in Germany are taking the place of steam. Consul-General Richard Guenther, of Frankfort, writes that after lengthy experimental tests, the German government will now proceed to establish electric-motor car traffic on 52 sections of the railroad lines in Prussia and Hesse. The estimated average speed will be 31 English miles an hour, which, however, can be increased to 37½ miles. More new cars are to be built during this year in order to extend this method of traction.

Naval Tests of Wireless are being made by experts of the United States Navy who are bending every effort toward perfecting wireless equipment, both telephone and telegraph, for use by the vessels and shore stations. The military authorities also are carefully investigating this subject through the Signal Corps. Both the navy and the army will be represented at a series of experiments to begin about June 15 at Brant Rock, Mass., where a high-powered wireless station has been erected by a concern which is endeavoring to secure the work of building and equipping a 600-foot tower in Washington. Special requirements are exacted as to the distance capability of the apparatus used.

Lights Controlled by Wireless was an interesting feature at the recent Omaha Electrical Show; the exposition was lighted through wireless telegraphy during one evening, the first time that a large lighting current has been controlled without wires. The system is a discovery of Dr. Frederick Millener, wireless expert of the Union Pacific. Four thousand incandescent electric lamps were controlled from a wireless telegraph station at Fort Omaha, five miles from the building. A dozen times during the evening Dr. Frederick Millener turned on and turned off every light in the big building from his station. The current, as sent out from the government wireless station at the fort, was picked up by the antennae on the roof of the Electrical Building. From this it passed to a coherer, which in turn set the current to energizing a four-ohm track relay. This relay closed a circuit solenoid switch, thereby turning on a seventy-five horsepower current and the lights flashed on.

Tests of Meters in New York City, according to the report of the New York Public Service Commission for April, shows that there were 31,155 gas and 136 electric meters tested in all. Of the meters tested on complaint, 29.2 per cent were two per cent or more fast, 13.8 per cent were two per cent or more slow, and fifty-seven per cent were between these limits and are therefore adjudged to be correct. The number of meters tested is not given.

The above statement is interesting in connection with the report made under date of April 29th by A. M. Hunt and C. L. Cory to the San Francisco Board of Supervisors covering the result of test of gas meters in San Francisco. The investigation of this committee included the test of 24 meters regarding which complaints had been made and of which seven of the meters were found correct within one per cent; twelve were fast, the average being 2.87 per cent; and five were slow, the average being 4.2 per cent. The maximum percentage fast was six per cent, and the maximum percentage slow was seven per cent.

The first lot of electric locomotives which the Pennsylvania Railroad Company will operate in the tunnels of the New York terminals has been ordered from the Westinghouse Electric & Manufacturing Co. It is understood that these locomotives will combine the most desirable features of electric locomotive design as determined by the tests conducted by the company with locomotives of different types on the West Jersey & Seashore and the Long Island railroads, and by the manufacturers at East Pittsburg. These tests have represented the expenditure of more than $500,000. It is understood that the locomotives will be the most powerful electric locomotives ever built, and will be of the articulated type, each locomotive to consist of two units. Each unit will be equipped with one 2000 horsepower direct current motor mounted above the frames and connected to the wheels by connecting rods and side rods. The locomotives will be able to attain a speed of 90 m. p. h., and the first two to be built will be ready for test in the early fall. The present order will consist of 24 double units, but it is probable that more will be required soon after the terminal station is opened.

Successful achievements in radio-telephony are reported from Italy, where the Director of the Superior Institute of Postal Telegraphy of Rome, S. Quirina Majorana, has for some years been experimenting. One of the most important improvements invented by Signor Majorana is his ingenius liquid microphone, based on capillary phenomena, which cause the resistance between platinum electrodes to vary according to the sound emitted; this instrument has been applied successfully to ordinary telephony, permitting conversation between the Institute and London. The Poulsen arc system is employed in producing the necessary oscillation for wireless telephony, but many modifications have been introduced into both the transmitting and receiving apparatus by Signor Majorana. Telephonic communication by this system has been carried out between Monte Mario, Rome, and Anzio, Ponza and Maddalena, which are distant 60, 120 and 300 km. respectively, and between the same station in Rome and the torpedo-boat Lanciere, which was at the time about 200 km. distant. The voice reproduction was so clear in these experiments that by it the speakers could be recognized. The latest experiments of Signor Majorana have enabled him to "call up" Trapani, Sicily, which is 500 km. from the Institute. In view of these experiments, it appears to have been decided to establish three stations on this system at Naples, Cagliari and Palermo respectively.

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FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Direct Current Motors at Portland

With the completion of a new system of underground distribution and a new sub-station in the business section of Portland, Oregon, direct current is to be substituted for the present practice of alternating current distribution. This change is in direct accord with the concensus of expert opinion as to the best method for handling a concentrated load close to the sub-station. It eliminates the voltage drop due to self-induction or reactance in alternating current circuits. This loss, in the case of the heavy cables necessary for low voltage distribution, is often much greater than that resulting from the mere line resistance. With direct current the resistance loss is negligible on light loads, and even with increasing load the efficiency of distribution is higher than in an alternating current system in which the resistance drop is but a small part of the total.

Furthermore, direct current affords much better voltage regulation. This redounds to the benefit of the consumer in allowing the use of high efficiency lamps, for with poor regulation their life is considerably less than that of the lower efficiency incandescents. It has been noted that the tantalum lamps burn much longer when supplied with direct current, the filament disintegrating rapidly with the other. As the lighting load is usually a more important factor in municipal supply than is the power load, this advantage compensates for some of the disadvantages associated with direct current.

First among the latter is the necessity of replacing all existing induction motors by the direct current type. In the case of Portland there will also be a number of 500-volt machines to be taken out, as the distribution pressure is 220 volts. This requirement is undoubtedly a hardship on some individuals, especially if they have but recently installed new equipment. But insomuch as by far the greater part of the power load in this locality is for elevator service, with heavy starting torque and varying speed control, wherein the induction motor is a poor servant, this change will ultimately be beneficial to the consumer. As the starting current of an alternating current motor amounts to almost a short circuit the new system should greatly improve circuit regulation, particularly if the dynamos be supplemented by storage batteries. There should also be a material reduction in the current bills of the consumer whose charge is based upon the maximum demand.

One objection raised is that the direct current motor, with its attendant commutator and brush troubles, requires more expert attention than does the simpler and more reliable induction motor. Too often these have been operated upon the principle of "You touch the button and we do the rest." A printing office where the pressman operates the electrical apparatus, forms a typical example. But even here a little instruction usually suffices to set the matter right.

Our advice to salesmen, however, is not to include Portland and vicinity in their schedule if their specialty be alternating current motors. There will be enough second-hand machines of that type to supply the needs of outlying sections for years to come.

GENERAL MANAGER FOR THE GREAT WESTERN POWER COMPANY.

H. H. Sinclair, Vice-President of the Edison Electric Company, Los Angeles, will take up the general management of the Great Western Power Company with headquarters at San Francisco on June 1st. Mr. Sinclair has just returned from a trip around the world and after spending the past week in San Francisco has departed for his home in Pasadena where he will complete his arrangements for the transfer of his residence to San Francisco from which point he will direct the work of the Great Western Company.

The Edison Electric Company, which serves a large district in Southern California, is capitalized at $13,000,000, while the Great Western Power Company, generating power on the Feather River in the northern part of California, is capitalized at $50,000,000. As Mr. Sinclair will continue in his position as Vice-President of the Edison Company the new arrangement will at least insure friendly co-operation between the two companies.

The first work of note undertaken by Mr. Sinclair in the electrical field in California was in 1892 when he built the plant of the Redlands Electric Light & Power Company; since then several important plants in Southern California have been built under his supervision and since their consolidation he has taken an important part in the direction of the Edison Electric Company.

Mr. Edward P. Bryan, vice-president of the Great Western Power Company, who has been for the past four months acting as general manager of this company, has in the short time he has been here made many warm and sincere friends. Mr. Bryan had just completed the great subway running below the city of New York, one of the most arduous and difficult problems of engineering ever attempted in America since John A. Roeblings designed and constructed the Brooklyn bridge. Feeling in need of rest he had just planned to take a trip around the world, when the imperative necessity of some one to take the active management of the Great Western Power Company arose, and his associates persuaded him to come to California and take charge temporarily. Mr. Bryan will now resume his interrupted journey and leave for Honolulu and Japan within the coming month.

In the above arrangement San Francisco and Northern California gain a great acquisition to their already large list of financiers. While Mr. Sinclair brings to the North his vast experience and well known executive ability, yet his heart and home will always be in his beloved Los Angeles and Pasadena, where his early success in life made for him his fame and fortune.

While the Journal but echoes the sentiments of welcome of the entire community to Mr. Sinclair, there is at the same time a sincere regret at the loss to San Francisco of one of the most noted engineers of the United States.

PERSONAL.

H. H. Sinclair, vice-president of the Edison Electric Company of Los Angeles, spent the past week in San Francisco.

W. M. Carpenter, Vice-President of the American Cross Arm Company, Chicago, is now in the Northwest and is expected in San Francisco early next week.

R. J. Davis of the Standard Electrical Works, San Francisco, is now making his home at the University Club, his home in San Rafael being closed for the summer.

J. C. Kirkpatrick, president of the American Cross Arm Company, Chicago, and general manager of the National Pole Company of Escanaba, Mich., spent the early part of the week in San Francisco and left for Los Angeles on Monday night accompanied by C. H. Johnson, manager of the pole department of the Western Electric Company on the Pacific Coast.

Bradley A. Fiske, Commander of U. S. S. Tennessee, which has formed part of the Pacific fleet stationed at San Francisco during the past two weeks, is an electrical expert and an inventor of reputation. Practically all of his work in this line has been done under the direction of the United States Government. Among his inventions are the Fiske range finder, the Fiske position finder and the engine room telegraph, very generally used by the Navy.

OBITUARY.

George P. Low died at Mill Valley, Cal., on Sunday night, May 23d.

Mr. Low had a wide acquaintance upon the Pacific Coast as a result of his close affiliation with the electrical business during the past twenty-five years. He was a writer of considerable note, having been one of the founders of the Journal of Electricity, Power and Gas and for many years its editor.

He is survived by a wife and two children, a boy and a girl.

SECOND-CLASS (OR ASSISTANT) STEAM ENGINEER. CUSTODIAN SERVICE, JUNE 16, 1909.

The United States Civil Service Commission announces an examination on June 16, 1909, at the places mentioned in the list printed hereon, to secure eligibles from which to make certification to fill a vacancy in the position of second-class engineer, $900 per annum, in the Custodian Service at Macon, Ga., and vacancies requiring similar qualifications as they may occur throughout the United States.

The examination will consist of the subjects mentioned below, weighted as indicated:

Subjects.	Weights.
1. Letter writing (a letter of not less than 150 words on some subject of general interest. Competitors may select either of two subjects given)	10
2. Practical questions in mechanical and electrical engineering (comprising the construction and operation of the heating plant and electric lighting and elevator machinery in first-class public buildings	65
3. Experience in mechanical and electrical engineering work	25
Total	100

Age limit, 18 to 55 years on the date of the examination. All honorably discharged United States soldiers and sailors of the war of the rebellion will be admitted to this examination without regard to the maximum age limit.

Persons who have suffered the loss of an arm or leg, who are ruptured, or who have other serious disability are considered physically disqualified for this position.

This examination is open to all citizens of the United States who comply with the requirements, but at the request of the Treasury Department, preference in certification may be given to legal residents of the county, including the city, in which the vacancy exists.

This announcement contains all information which is communicated to applicants regarding the scope of the examination, the vacancy or vacancies to be filled, and the qualifications required.

Applicants should at once apply either to the United States Civil Service Commission, Washington, D. C., or to the secretary of the board of examiners at any place mentioned in the list printed hereon, for application Form 1052. No application will be accepted unless properly executed and filed with the Commission at Washington. In applying for this examination the exact title as given at the head of this announcement should be used in the application.

As examination papers are shipped direct from the Commission to the places of examination, it is necessary that applications be received in ample time to arrange for the examination desired at the place indicated by the applicant. The Commission will therefore arrange to examine any applicant whose application is received in time to permit the shipment of the necessary papers.

THE PROPER CHANNELS OF DISTRIBUTION OF ELECTRICAL SUPPLIES.

The following paper was read at the meeting of the Pacific Coast division of the National Electrical Jobbers' Association held at Del Monte, California, April 24th, and formed the basis of the principal discussion of the meeting.

The purpose of the paper is purely educational, the object being to define the proper channels of trade and without lessening the distribution of manufactured product, to so arrange that distribution as to obviate the trouble and friction that must necessarily ensue when manufacturers or their agents interfere with or encroach on the distributing rights of the jobber or when the jobber takes from the contractor or retailer that which is legitimately his.

This paper was prepared by a special welfare committee appointed for that purpose.

In commercial life, there seems to come in the evolution and development of every line of manufacturing and distributing, a period of unrest; an uncertainty as to the natural and most economic method of distributing a manufactured article from the factory to the consumer. With the older lines of business, such as hardware, groceries, dry goods, etc., this question was long ago thrashed out and a very satisfactory conclusion reached from a theoretical standpoint, and it must be admitted a fairly satisfactory conclusion reached from a practical standpoint. From a strictly ethical view, the all important feature is, that the consumer, that great body that forms the ultimate support of all manufacturers, shall purchase his supplies at reasonable and economic prices. We use the word "reasonable" in connection with the word "economic," as the item of dollars and cents is not the only feature in purchasing that goes to make economy, but time, service and delivery are equally important.

The electrical supply business is comparatively new and its development has been very rapid in the last few years. The increased development of electric current, its advent in practically all civilized portions of the world, the lessened cost, and the multiplicity of uses brought into play have naturally increased not only the quantity but the variety of the output of manufacturers, and this process of evolution is still in rapid progress. With the widened distribution of the electric current and the enormous increase in application thereof, the question of economic distribution of those manufactured goods becomes of vital importance. Where formerly purchasers of electrical supplies were limited almost entirely to electric power and lighting companies, it was natural that business relations should be confined almost exclusively to the manufacturer and those purchasers. Other than this, electrical supplies were handled principally by contractors whose stocks gradually expanded to the magnitude of jobbing stocks. As time went on, it appeared that contracting was an operation distinctly separate from the jobbing business and at the present time the jobbers throughout the United States no longer engage in construction work. But with the expansion of electric power, however, into our mines, lumber mills and other industrial plants of infinite variety, electrical supplies become closely akin to general hardware, groceries, dry goods and other manufactured commodities that are distributed generally and widely to our entire population. As has been the case with these latter commodities, so it must naturally follow that the proper channels and the most economic channels for the distribution of electrical supplies must be:

First: From the manufacturer to the jobber or wholesaler;

Second: From the jobber or wholesaler to the contractor or retailer,

Third: From the contractor or retailer to the consuming public.

These channels have been justified time and again with other lines of trade and have been proven in the past, and can be proven in the present and in the future, the most reasonable and ultimately the most economic for all parties interested, that is, from the manufacturer clear down the line to the ultimate consumer.

A brief argument in justification of these ideas might be allowed. In the first place, the duty and province of the manufacturer is to originate and build, or manufacture certain commodities. He then seeks the line of least resistance in disposing of those commodities; he finds this channel in the jobber or wholesaler. By confining his sales to this class of buyer, his selling expense is maintained at a minimum, whereas, if he disregards the wholesaler, he must multiply his sales force and expense of distribution many times in seeking other classes of trade. Every manufacturer has a more or less limited line of commodities, while it is the province of the jobber or wholesaler to gather together as many lines of various manufacturers as are analogous and distribute them through one economic system. As the manufacturer finds, we will say some few hundred branches of distribution in the jobber, so the jobber finds many times those few hundred branches of distribution through the retailer or contractor. In other words, the latter are to the jobber exactly what the jobber is to the manufacturer. Just as in the previous case, if the jobber seeks the trade of the public, generally, he must increase his general force, and particularly his expensive selling force to such an enormous point as to treble or quadruple his cost of selling.

It must be admitted that in isolated cases where the consumer succeeds in making an occasional purchase from the jobber, he purchases at a lesser price than he would from his nearest retailer or contractor. Such isolated cases, however, in no way destroy this argument, for if the retailer or contractor were eliminated altogether, then the jobber would be the only source of supply for the general public, and the cost of distribution would necessarily be increased as already outlined. Therefore, we repeat that time and practice have definitely proven the most logical, reasonable and economic channels of distribution from manufacturer to the ultimate consumer, to be as herein stated.

From time to time there appear in trade journals articles apparently inspired by someone seeking to gain some temporary advantage over his competitors, claiming that the day of the wholesaler or middle man has passed, and this intermediate channel of distribution must give way to the more direct channel, from the manufacturer to the retailer or consumer. Such articles are apt to cause temporary interruption in the natural flow of trade, but the interruption is only temporary and manufacturers soon find that these inspired and visionary ideas are false in every detail and a proper resumption of the flow of trade results.

The elimination of the jobber and jobbing stocks would force the contractor or retailer to purchaser at long range, in some cases as much as 3,000 miles, from hundreds of manufacturers. His orders in most instances would be for less than minimum weight shipments, and the capital employed in his business would have to be doubled or trebled; his stock on hand would become extremely large and unbalanced, with the possibility of enormous shrinkage in values due to the everchanging character of "Code" staple articles.

This would seem to establish the fact that all interests involved, from the manufacturer to the ultimate consumer, are benefited or injured according to the harmonious or inharmonious relation of these interests to each other. Assuming that the manufacturer is sincere in his desire to confine his business to the jobber, the greatest trouble generally arises through the representative of the manufacturer, particularly in the person of the manufacturer's agent. Unless such representative is properly coached and is sincere and earnest in endeavoring to follow out the wishes of the manufacturer, constant friction and trouble between seller and purchaser must ensue.

Manufacturers' agents should be divided with a well-defined line into two classes. First: Agents representing large and responsible manufacturers whose commodities are distributed solely through the jobbing trade. Second: Agents or representatives of smaller factories, or those manufacturing only such specialties as are not handled or sold by the jobbing trade, but which through their very nature as specialties are handled direct to the retail, contracting or consuming trade. One great trouble is that manufacturers' agents frequently neglect to recognize the dividing line between these two classes, and agents handling a jobbing line should not handle a retail line. A definition of a legitimate manufacturers' agent, who, as such, is entitled to the jobbers' support, would seem to be in order here and we offer the following:

"An agent who confines his sales to jobbers exclusively on all articles carried in stock by any jobber in the locality where the manufacturer's agent operates."

The relation of the jobber to the contractor or retailer is a little more difficult to define, but the same general principles underlying the relations of the manufacturer and jobber must be applied. By this, we mean that just as the manufacturer and jobber should mutually respect each other's rights, so the jobber and the retailer or contractor should have the same mutual respect, and the jobber should not compete with the retailer just as the latter should not attempt to do a jobbing business.

It should be the duty of every jobber to see that the contractor or retailer is properly protected in his business not only as to purchasing, but by a well defined policy of non interference with the strictly retail trade. The financial success of the retailer or contractor is essential to the financial success of the jobber just as the success or failure of the jobber must mean a profit or a loss to the manufacturer.

Much can be done to remove present difficulties if the contractor or retailer would confine his purchases exclusively to the jobbers in his locality, which would place him in position to demand of the jobber such consideration as would give him assured protection.

One of the greatest difficulties in this relation of wholesaler to retailer is to define classes of trade that should legitimately buy from the jobber or wholesaler as a part from those whose business should lie solely with the contractor or retailer, and as a step in this direction of defining the classes of trade that should be entitled to wholesale prices on electrical supplies, we offer the following:

"Those engaged in generating and distributing electric current, electrical contractors, dealers in electrical supplies or fixtures, steam and street railroad companies, steamship companies, Telephone and Telegraph companies, municipalities, branches of the U. S. Government, of the State Government, universities, ship building companies, oil companies, manufacturers who purchase electrical apparatus or supplies for resale in combination with their own product, industrial enterprises such as lumber manufacturing companies, mining companies, cement manufacturers. Purchasers other than the above should legitimately buy from the contractor or retailer."

While on the surface this definition seems to take in a large list of consuming buyers, still those buyers are of such magnitude and importance in their relation to the entire community as to warrant their consideration from the jobber or wholesaler. It is conceded that this condition is subject to change and correction as affected by time and progress, but practice and experience justify this position at the present.

WATER POWER IN OREGON.

In a recent government publication it is stated that the most important streams in Oregon for development of water power are those heading in the high, perpetual snow-clad Cascade Mountains and dropping rapidly to the sea level. Of these streams, the Deschutes River, having a minimum flow of 5100 cubic feet per second, and flowing through a narrow canyon in solid rock for 90 miles above its mouth, is the most important. This stream parallels the Willamette Valley and flows into the Columbia River 90 miles east of Portland. It has 3480 feet fall from Bend to its mouth, 500 feet of this being in the last 36 miles. Within this distance of 36 miles 290,000 theoretical horsepower can be developed. This, at the extremely low value of $10 per horsepower per year, would produce an annual revenue of nearly $3,000,000.

Hood River falls 740 feet in the last 11 miles of its course. It will furnish 2800 brake-horsepower per mile.

The McKenzie River has an average low-water flow of about 2200 cubic feet per second. Its fall is 11.5 feet per mile in the vicinity of Eugene and 26 feet per mile at Belknap Bridge. In the 39 miles above Hendricks Ferry its fall averages 16.7 per mile.

The North Fork of the Santiam River has a minimum flow of 727 cubic feet per second at Mehama. It falls 14.9 feet per mile in the vicinity of Mill City and 66.3 feet per mile near Idanha, 21 miles above. The average in this region is 37.5 feet per mile.

Fifteen thousand electric horsepower is now being developed at Cazadero, on the Clackamas River, and about 12,000 horsepower at Oregon City during the low water in the Willamette. At Gold Ray, in southern Oregon, on the Walla Walla River, and at Rock Creek, in eastern Oregon, large hydro-electric power plants are in operation. A large plant is being constructed near Portland, on the Sandy River.

SEATTLE ELECTRIC TRIES NEW BRAKE.

The Seattle Electric Company of Seattle, Wash., is experimenting on the West Queen Anne lines with an electro-magneto brake. The device has responded to all tests put upon it to date and the officers of the company state that if it proves as successful in Seattle as it has in other cities danger on the hill street car lines will be greatly lessened. A car equipped with the new brake and carrying officers of the company was run up and down Queen Anne hill recently without the use of the counterweight. The car was under control at all times. The tests will be continued for another two months, however, before the use of the brake is made general.

The brake consists of a shoe which rests on the track between the car trucks. Attached to this is a magnet, which is under control of the motorman by means of a "point switch." By throwing current into the magnet an attraction is set up between the rail and the shoe, which may be varied in intensity at the will of the motorman. The braking force is the friction between the shoe and the track, and also the pull of the magnet. The new brake is so arranged that if the trolley pole leaves the wire the brake automatically sets. The greater the speed of the car the harder the brake sets.

The particular feature of the new brake is that it does away with the flat wheel nuisance. As the device works on the track only, the wheels are never locked and cannot slide.

"The new brake," said E. E. Potter, general manager of the Seattle Electric Company, "has been indorsed by the British Society of Engineers and has been in use in Pittsburg, Los Angeles and other cities of the United States. The brake we are experimenting with is an advance over most of those now in use elsewhere. A similar device is used in Portland on the Portland Heights line and has given satisfaction.

"We are now experimenting with the brake to find its effect on the motors. As it releases when the current is off the motors and the motors work going down hill as well as up, there is a strain on them which may have an injurious effect. We want to see whether the insulation can stand the strain that is put upon it.

"Otherwise the brake works well. We will use it if it is found to be serviceable. We will use it on the Queen Anne lines as an auxiliary to the counterweight system. It is probable that it will be fitted to all cars which climb a grade of from 6 to 9 per cent."

TRADE NOTES.

It is stated that the orders of the General Electric Company since the first of February have been running at the rate of between $51,000,000 and $53,000,000 a year. The orders received in the last fiscal year aggregated $41,000,000, and in the fiscal year ended January 31, 1909, about $60,000,000. The management is of the opinion that orders for the current year will equal those reported in any year since the company was organized.

The Simmen automatic safety device, installed on the Atchison, Topeka & Santa Fe Railway in California some months ago, has proven satisfactory. This new invention entirely dispenses with the telegraph operator. Each train as it passes over the road automatically makes a record on a sheet in the train dispatcher's office. By means of red and green lamps and a gong the dispatcher can at any time signal direct to the engineer to stop, slow down or proceed.

The Arthur D. Little Laboratory announces the incorporation of their company under the name Arthur D. Little, Incorporated, for the purpose of operating a laboratory of engineering chemistry at 93 Broad Street, Boston. The business of this laboratory was established in 1886 and it is the present intention to extend their facilities and through its large staff of specialsits to undertake any work involving the application of chemistry to industry.

The Holophane Company of New York has moved its general offices, with the headquarters of the sales and engineering departments, to Newark, Ohio, where the Holophane Glass is manufactured. The business of the company has been handled up till now from New York city, but in the interests of prompter shipments and to better serve the steadily increasing market, the concentration of the entire organization was deemed advisable. The branch offices of the sales department, located in New York, San Francisco, Boston and Chicago, however, will continue as before. It is an interesting indication of Holophane system that only one working day was lost between the cessation of the business in New York and the opening in Newark. Practically the only inconvenience experienced by customers was due to delay caused by mail being misdirected to New York after the closing of the old office.

During the past ninety days Allis-Chalmers Company has taken contracts for upwards of thirty (30) steam turbines and generators, aggregating in capacity nearly 50,000 k. w. and negotiations are now pending for more than double that number. Among the orders recently placed is one for a unit of 2000 k. w. for the Public Service Corporation of New Jersey, to be installed at Camden, another of 2000 k. w. purchased by the Stone & Webster Engineering Corporation for the El Paso Electric Railway Company, El Paso, Tex., and a 2000 k. w. machine to be placed on a "repeat" order in the Public Service Station of the city of Columbus, Ohio.

Among the orders just booked are three gas engines aggregating 1000 h. p., direct connected to three Allis-Chalmers electric generators, for the Palmetto Phosphate Company, Tiger Bay, Florida, a gas engine of approximately the same size, with generator, for the Armstrong Cork Company's plant at Camden, N. J., a 1500 k. w. gas driven electric unit and seven Standard 30,000 cubic feet gas driven blowing engines for various blast furnace plants.

In the power and electrical field figures obtained for March and April from the largest builder in this country of all types of prime movers as well as of electric generators, transformers, motors, etc., viz.: Allis-Chalmers Company, show a large number of contracts for plants of moderate size, averaging about 400 horsepower, the aggregate of apparatus for which represents the enormous capacity of 61,985 horsepower. Among the larger purchasers are the San Angelo Water Works Company, San Angelo, Texas; Pacific Gas & Electric Company, San Francisco, Cal.; Northern Idaho & Montana Power Co., Sand Point, Idaho; Utah Light & Railway Co., Salt Lake City, Utah; Union Pacific Coal Co., Omaha, Neb.; Texas Pacific Coal Co., Thurber, Texas; El Tiro Copper Co., El Tiro, Ariz.; Intercolonial Railway of Canada, Moncton, N. B.. Particularly noteworthy of present activity is a contract placed with Allis-Chalmers Company by The Milwaukee Electric Railway & Light Company, John I. Beggs, president, for two 1500 k. w. motor-generator sets, one 500 k. w. balancer, six 2000 k. w. transformers, two 300 k. w. transformers, two 300 k. w. motor generator sets and a 300 k. w. generator of the water-wheel type, much of this apparatus constituting a "repeat" order.

Following the recent decision of the Illinois Supreme Court, which concluded the protracted litigation due to the disputed ownership of the stock of the Kellogg Swithboard & Supply Company, Chicago, the former owners of the company, including Milo G. Kellogg, who established the business, and his associates, are now in possession of the business and factory of the company. The American Telephone & Telegraph Company has restored to its previous owner every ceretificate of stock of the Kellogg Company. On April 27 the reinstated stockholders of the Kellogg Company met and elected a board of directors consisting of Messrs. Milo G. Kellogg, Francis W. Dunbar, Kempster B. Miller, Leroy D. Kellogg, J. B. Edwards, James G. Kellogg and Wallace L. DeWolf. All of these gentlemen, with the exception of Mr. DeWolf, are representatives of the old ownership of the company. The directors elected the following officers: President, Milo G. Kellogg; vice-president, Leroy D. Kellogg; secretary and treasurer, Seymour Guthrie; executive committee, L. D. Kellogg, Francis W. Dunbar and J. B. Edwards. This proceeding places the company back in the ranks of the independent telephone manufacturers. It is reported that the company is doing a large business. Mr. J. B. Edwards is the general superintendent and Mr. Francis W. Dunbar is the chief engineer.

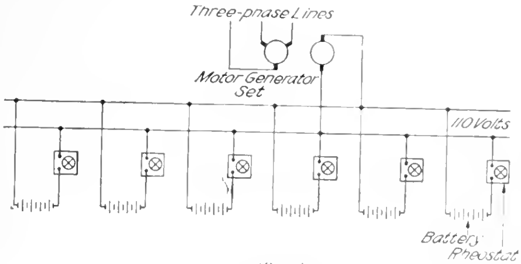
The effort that has been made by electric traction companies, despite the recent business depression, to keep their systems in good operating conditions, is not generally recognized; but one evidence recently brought to the attention of this paper is the fact that since January 1st, of this year, Allis-Chalmers Company, one of the largest builders of street and interurban railway apparatus, has received orders for nearly 1000 air-brake equipments. These include the company's latest type of straight air brakes for single car operation, straight air emergency equipment, combined straight and automatic air brake equipments for 2 or 3 car-trains and automatic air brake equipments for electric locomotives and heavy interurban trains. Among the companies buying are the following: Tampa & Sulphur Springs Traction Company, Tampa, Fla.: Third Avenue Railway Company, New York; Tarrytown & White Plains Railway Company, White Plains, N. Y., Yonkers Street Railway Company, Yonkers, N. Y.; Omaha & Council Bluffs Street Railway, Omaha, Neb.; Conestoga Traction Company, Lancastér, Pa.; Ogden Rapid Transit Company, Ogden, Utah; Atlantic Shore Line Railway Company, Kennebunk, Me.; General Construction Company, Omaha, Neb.; Sandusky, Norwalk & Mansfield Railway Company, Norwalk, O.; Shelbourne Falls & Colrain Street Railway Company, Shelbourne Falls, Mass.; Chester Traction Company, Chester, Pa.; Lebanon Valley Street Railway Co., Lebanon, Pa.; Rochester Railway Company, Rochester, N. Y.; Eastern Wisconsin Railway & Light Company, Fond du Lac, Wis.; Transit Supply Company, Minneapolis, Minn.; Chicago City Railway Company, Chicago, Ill.

INDUSTRIAL

BATTERY CHARGING IN AUTOMOBILE GARAGES WITH MERCURY ARC RECTIFIERS.

In many electric automobile garages having a capacity for charging two or more batteries at one time, the charging is done directly from direct current feeders or through a motor generator set from alternating current feeders. The general connections are similar to those shown in Fig. 1 either with or without the motor generator. There are a small number of garages using single curcuit rectifier outfits, one for each battery to be charged, but while this method is very satisfactory and highly efficient, the cost of the original installation is rather more than most garages care to invest for this purpose.

A large number of charging garages are now using the public garage type of rectifier, which is described later in this article.



	Circuit						
	No. 1.	No. 2.	No. 3.	No. 4	No. 5	No. 6.	Totals.
No. cells.........	44	40	30	24	16	12	166
Vols av...........	101	92	69	55	37	28	....
Amps. av.........	20	20	20	20	20	20	120
Watts used	2,020	1,840	1,380	1,100	740	560	7,640
Watts lost.......	180	360	820	1,100	1,460	1,640	5,560
Watts total	2,200	2,200	2,200	2,200	2,200	2,200	13,200
Per cent. eff......	92%	84%	63%	50%	34%	25%	58%

Fig. 1. Diagram of Connections and Table for Charging Batteries From Motor Generator.

Referring again to Fig 1, let it be assumed that six batteries are to be charged from the 110 volt circuit, and that the number of cells in the various batteries is as follows: No. 1, 44; No. 2, 40; No. 3, 30; No. 4, 24; No. 5, 16; No. 6, 12. The tabluation in Fig. 1 shows the actual watts delivered to the battery, the watts lost in the rheostats and the efficiency of each circuit, neglecting the loss in the motor generator set. It will be seen from the last column that the efficiency of the complete system, exclusive of the motor generator set will be about 58 per cent; with the motor generator set having an approximate efficiency of 75 per cent, the efficiency of the system will average about 44 per cent.

The public garage type of mercury arc rectifier is shown in Fig. 2. This outfit is designed for use on a 220 volt 60 cycle alternating current circuit and consists of a two-panel dull black slate switchboard with necessary regulating compensator, reactance, equalizing rheostats, rectifier tubes and necessary switches, all suitably mounted with a view to obtaining the most compact and convenient equipment possible. The left-hand panel of the switchboard is known as the rectifier controlling panel and on it is mounted the apparatus particularly essential to the starting of the rectifier tube and regulation of the rectified current.

The right-hand or charging circuit panel is equipped with six triple pole double throw switches which lead to the various charging circuits, two 60-amp. ammeters and a 6-point voltmeter switch for adjusting one of the voltmeters on the left-hand panel for reading the voltages of the various batteries being charged.

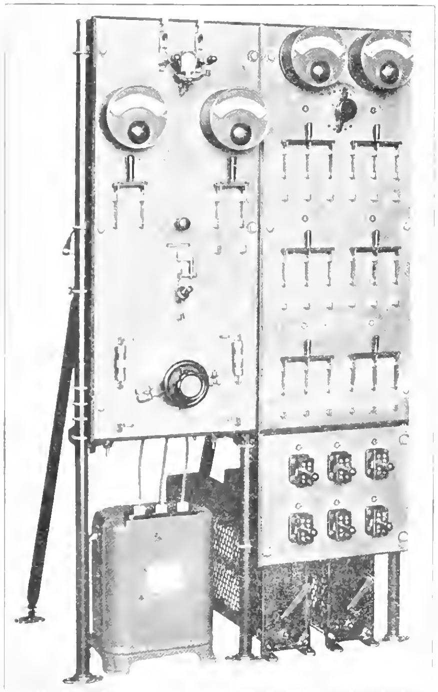
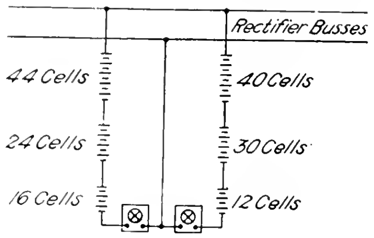


Fig. 2. Public Garage Type of Rectifier.

The general scheme of connections of the charging circuits on the garage panel is outlined in Fig. 3. The rectifier when charging a group of batteries similar to that shown in Fig. 1 would supply an average of about 193 volts on the charging circuit. It will be noted from Fig. 3 that the six batteries are arranged in two circuits of three batteries each, the batteries being equally divided between the two circuits. The tabulation just below the diagram gives the losses and efficiencies when charging with these connections. It will be noted from this table that the average efficiency of the charging circuits alone neglecting the very small losses in wiring is 99 per cent. As the efficiency of the rectifier when delivering 193 volts is about 84 per cent, the total combined efficiency if the complete charging equipment would be about 82 per cent.

Referring to the table in Fig. 1, it will be seen that

the total watts used in the charging circuits is 13,200. At 75 per cent efficiency this would mean an input to the motor generator set of about 17.6 kilowatts. The input to the rectifier under the conditions shown in Fig. 3 would be about 9.2 kilowatts, representing a saving of 8.4 kilowatts for each hour of operation under similar conditions. Of course, a small part of



	Circuit No. 1.	No. 2.	Totals
No. cells	84	82	166
Volts av.	193	189	....
Amps. av.	20	20	40
Watts used	3,860	3,780	7,640
Watts lost	0	80	80
Watts total	3,860	3,860	7,720
Per cent. eff.	100%	98%	99%

Fig. 3. Diagram of Connections and Table for Charging Circuits for Garage Outfit.

this saving would have to be used for buying renewal tubes for the rectifier, but even considering the slight additional expense, the saving in power could figure out at least 20 or 25 per cent.

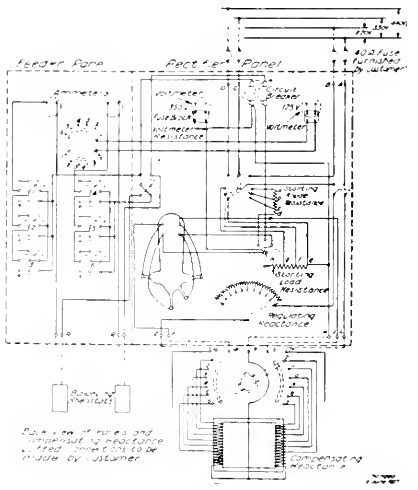


Fig. 4. Diagram of Connections of Rectifier Outfit for Garage Service.

While some garage operators might consider the combination of cells given in the foregoing example as an unfavorable case, it should be borne in mind that batteries of the various number of cells mentioned are furnished by representative electric vehicle manufacturers for use in their "Electrics." Nor is it possible for a garage to control the conditions and make them most favorable to the charging plant; for example, garages are frequently called upon to charge a single battery with a large number of cells, say a 40-cell battery, and a large number of batteries with a smaller number of cells, for instance, 5-24-cell batteries. When charging such a group of batteries from a 110-volt direct current circuit, the efficiency would be about 44 per cent. When charging the same batteries with a rectifier, the efficiency would be about 75 per cent.

The following tabulation of efficiencies when charging various sizes of batteries is given below. For the sake of comparison, the charging rate on all batteries is taken as 20 amps. and the average volts per cell as 2.3. While some batteries are designed for a heavier charging rate, the average battery can be efficiently and economically charged at this rate, although the time of charging may be somewhat longer.

There are, of course, almost innumerable combinations of batteries possible, but the above will give the general basis for comparison between the various methods of charging.

It will be noted from Fig. 4, which is a complete diagram of connections of the rectifier garage set, that when a battery is connected to the terminals of each of the triple pole switches marked and and the switches thrown in the upper position, the batteries are connected in two series groups similar to Fig. 3. If all the 12-cell batteries are to be charged at one time they may be charged in series by simply reversing the position of a double pole, double throw switch on the left-hand panel. For practically all charging, however, the circuits will be connected in series multiple as shown in Fig. 3.

In each of the two series charging circuits is connected a 60-amp. ammeter and a rheostat for equalizing the current between the two circuits. In order to use as little of the resistance as possible the number of cells of battery should be arranged to be as nearly equal as practical. When it is desired to cut out a battery for any reason the switch to which this battery is connected should be opened, a sufficient amount of the charging rheostat cut in and the switch thrown into the upper position. This cuts out the battery, but the series circuit is not broken and the charging of the remaining batteries will be continued.

A sub-base shown below the right-hand section in Fig. 2 is sometimes furnished. This sub-base is equipped with six non-reversible plug receptacles and six charging plugs. To these plugs should be attached six charging cables leading to various points in the garage. The use of this sub-base permits of readily changing the various batteries under charge from one circuit to the other in order to make the most efficient combination without moving the vehicles from place to place in the garage.

With this type of rectifier it is possible to charge at one time a total of 180 cells of lead plate battery at 20 amps. each.

About 30 of these garage panels are now in actual service, giving excellent results and proving that the above efficiencies outlined are not merely theoretical.

FIXTURES FOR WHITNEY BUILDING.

The contract has been placed for several hundred lighting fixtures for the new Whitney Building now under construction on Geary street, San Francisco. They are to be the new type

New Benjamin Fixture.

of fixture manufactured by the Benjamin Electric Manufacturing Company of Chicago and contract calls for their complete equipment with Holophane E type reflectors and Benjamin angle sockets fitted for tungsten lamps.

This is a new type of fixture recently brought out by the Benjamin Company and is shipped packed one in a box, wired complete, ready for installation.

NEW CATALOGUES.

Keuffel & Esser Company of Hoboken, N. J., has issued the 33d edition of its catalog of drawing materials and surveying instruments. A new feature of the catalog is a special section for drafting office furniture, which now forms an important department among the goods manufactured.

The Westinghouse Air Brake Company has issued a new instruction pamphlet entitled "The Type K Triple Valve." The book is known as Instruction Pamphlet No. 5030 and contains a complete description, with drawings, of the latest design of this valve, together with instructions for its installation and operation.

The General Electric Company is just issuing a Bulletin devoted to Tungsten Economy Diffusers, which supersedes a previous publication on this subject. The new Bulletin, No. 4660, goes more into detail and contains illustrations of this diffuser in connection with fixtures of various designs. This publication will be of interest to those contemplating the use of Tungsten lamps.

The Sterling Varnish Company of Pittsburg, Pa., has issued a "Catalog of Insulation," in which the company's various materials are described and the directions for their use given, making the booklet or practical value. Among the company's products are extra insulating varnish, black plastic insulator, Motorlac, extra black finishing varnish, black armature lacquer, black air drying varnish, black core plate varnish and black insulating paint. The contents of the catalog also include the care of insulating compounds and their thinning, comparison of thermometerical scales, comparison of Beaume and specific gravity scales, specific gravities, solvents, baking and dipping coils, dipping tanks and baking ovens.

The H. W. Johns-Manville Company of San Francisco, Seattle and Los Angeles, are distributing a very tasty little pamphlet descriptive of the J-M Permanite Sheet Packing. It calls attention in a brief way to the various conditions under which this material can be used to advantage.

The H. W. Johns-Manville Company are distributing as the latest issue from the J.-M. Press a pamphlet entitled "A Story in Black and White." It treats of J.-M. asbestos roofing, giving briefly some interesting facts relating to the mining of asbestos, the plants where asbestos roofing is manufactured and some details covering the method of manufacture and the advantage of its use.

The Standard Engineering Company, 69 Natoma street, San Francisco, has issued a very attractive reprint of the article on a "Modern Hospital Power Plant" which appeared in the "Journal of Electricity, Power and Gas," under date of of April 17th. It covers a complete description of the installation of the power plant in the new Southern Pacific Hospital at San Francisco and a copy will be mailed on request to any one interested.

The Electric Storage Battery Company, Philadelphia, Pa., and San Francisco, has instituted a campaign consisting of a series of newspaper advertisements for central stations who want more power business. This series include a fine line of forceful, illustrated advertisements, bringing out the utili y and feasibility of operating electric carriages and electric power wagons. The plates are so arranged that all that is necessary for use in any city is the setting up of the name of the central-station company.

The General Electric Company has recently issued Bulletin No. 4658 describing the Type US-14 Ball Bearing Trolley Base. The type of double ball-bearing used on this base produces an extremely sensitive action which, by eliminating the arcing, pounding, wrenching, etc., inherent in ordinary forms, insures, a minimum wear on trolley wheel and overhead construction. A cushioned stop is provided to protect the pole from bending or breaking should the wheel leave the wire. This publication contains, also, a list of supply parts for this base.

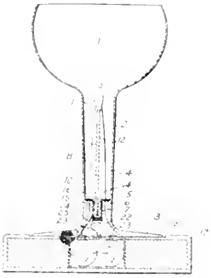
In Bulletin No. 4659, just being issued by the General Electric Company, are described some switchboard instruments for use on alternating current circuits, and constructed on the induction principle. Ammeters, voltmeters and wattmeters are made in this type of instrument, and are constructed so as to be uninfluenced by stray fields. Indications of the pointer are rendered "dead beat" and the scale extends through an arc of 300 degrees and is practically uniform throughout. This Bulletin contains catalog numbers, prices and dimensions of this instrument.

The Fort Wayne Electric Works, Fort Wayne, Ind., calls particular attention to the following bulletins just put out: No. 1112, on Type D. C. P., enclosed direct-current arc lamps, Form C, for operation on power circuits; No. 1115, on single-phase intergrating induction wattmeters; No. 116, on Type DCM enclosed direct-current multiple arc lamps. All are handsomely illustrated and complete in technical detail. The company is the well-known manufacturer of the "Wood" systems, and any pamphlet sent out by its publication department is worthy the closest attention.

Circular 1502 issued by the Westinghouse Electric & Manufacturing Company contains much valuable information on alternating current distribution covering transformers, lightning arresters, insulators, cross arms, etc. Considerable space is devoted to underground and overhead construction applicable to congested and scattered districts. There is also given information on potential regulating systems. The circular contains 52 pages of information of value to any central station man or any other connected in any way with the distribution of power by alternating current lines.

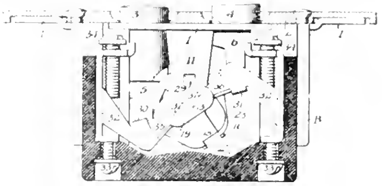
PATENTS

919,691. Electrically-Illuminated Drinking-Glass. Joseph [illegible] Cahill, St James, N. Y. In a drinking glass having an opening extending from the bottom of its bowl through its [illegible] and base, the combination with a glass tube, an incandescent electric lamp in the upper end of said tube, a plug [illegible] the lower end of said tube and conducting wires leading



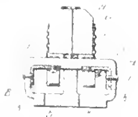
there from within said tube to said lamp, a lamp socket secured within said opening in the glass adjacent to its base and electrically and mechanically connected with said lamp and supporting said tube and lamp, a sub-base for the glass, an electric battery within said sub-base, and electric conductors between the said battery and lamp socket whereby the incandescent electric lamp is illuminated.

921,050. Snap Switch. James H Wyatt, Philadelphia, Pa., assignor to William M Scott, Philadelphia, Pa. In a snap switch, the combination with a pivoted contact carrying member, of a detent member engaging and rotating with the same, ears upon said detent member, a spring en-



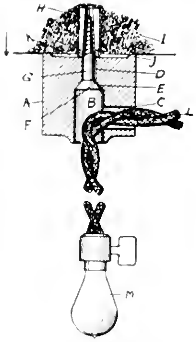
gaging said ears to hold said detent member in normal position, an operating spring, a spring winding member, and a projection on said spring winding member disposed between said contact carrying member and its axis of movement for engaging said ear upon said detent member to shift the same.

921,196. Detachable Plug. Puzant R. Yuzuk, New York, N. Y., assignor to General Electric Company, Schenectady, N. Y. In a detachable [illegible], the combination of an insulating



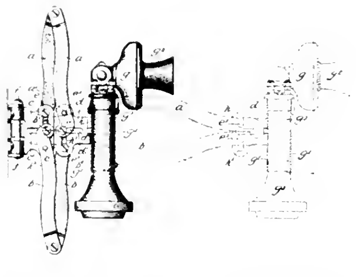
[illegible] contacts [illegible] on the front side thereof, [illegible] located on the back side of said base portion for securing it to a socket and electrically connecting said contacts to the circuit, a terminal bearing portion readily detachable from said base portion and said contacts, a fuse link interposed in the circuit and carried by said base portion on its front side, and a cover secured to said base portion and situated between the front side of said base portion and said terminal bearing portion, said cover having openings for the terminals of said terminal bearing portion.

921,038. Ceiling Rosette for Drop Electric Lamps. William Wilbraham, Chicago, Ill. A rosette consisting of a block of insulating material having an axial passage extending through the block and a lateral perforation in the wall of the passage, said passage being provided with an internal shoulder



above the lateral perforation to receive the head of an attaching screw inserted in the passage; whereby the block may be secured to a wall by such screw and a conductor may be passed through the perforation and thence downward in the open portion of the passage, substantially as set forth.

921,367. Adjustable Bracket. Edward B. Craft, Chicago, Ill., assignor to Western Electric Company, Chicago, Ill. An adjustable supporting bracket comprising opposed toggle levers pivotally united at their ends, supports for said levers having main slots in which said pivots reciprocate, said



supports having slots therein at right angles to said main slots, and pins carried by said levers adapted to travel in said angular slots, whereby compound tram movements may be imparted to said levers, and force applied to said bracket other than in the direction of contraction or expansion is incapable of varying the adjustment thereof.

NEWS NOTES

FINANCIAL.

LONG BEACH, CAL.—The Alamitos Water Company has issued bonds to the amount of $200,000 for improving its system.

OAKLAND, CAL.—The Burk's Oil Company has levied an assessment of five cents per share on the capital stock of the company.

SAN FRANCISCO, CAL.—The Olympic Salt Water Company has levied an assessment of $1 per share on the capital stock of the company.

VISALIA, CAL.—The Wutchumna Water Company has levied assessment No. 131 of $10 per share on the capital stock of the company.

SAN FRANCISCO, CAL.—The Apollo Oil Company has levied assessment No. 1 of two cents per share on the capital stock of the company.

GLENDALE, CAL.—Bonds have been issued by the city council of this city to the amount of $60,000 for the construction of municipal electric light works.

OAKLAND, CAL.—The Central Oakland Light & Power Company has applied for permission to increase its bonded indebtedness by $800,000. The company proposes to increase its systems and acquire additional facilities in the near future.

INCORPORATIONS.

FRESNO, CAL.—The Merrill Oil Company has been incorporated here with a capital stock of $250,00 by A. L. Weil, M. Syme, L. Behrendt and Jesse Mueller.

SAN FRANCISCO, CAL.—The Economic Gas Company has been incorporated here with a capital stock of $1,500,000 by D. O. Druffel, H. P. Eberhard and Nicholas Bowen.

EUREKA, CAL.—The Pacific Oil & Fuel Company has been incorporated here with a capital stock of $10,000 by A. C. Dauphiny, A. C. Barrett, A. I. Streeter, and L. Dauphiny.

FRESNO, CAL.—The Boychester Oil Company has been incorporated here with a capital stock of $100,000 by W. C. Rielly, A. E. Shaw, C. T. Buss, J. B. Derruette and S. R. Adams.

FRESNO, CAL.—The Clovis Oil Company has been incorporated here with a capital stock of $100,000 by C. E. Boyd, I. S. Knight, T. W. Pond, A. G. Ehman and L. L. Eversoll.

LOS ANGELES, CAL.—The Newport Bay Electric Light & Power Company has been incorporated here with a capital stock of $50,000 by W. H. Paden, C. H. Ghrist and W. W. Crosier.

SAN FRANCISCO, CAL.—The Stauffer Oil Company has been incorporated here with capital stock of $100,000 by C. d'Guigne, John Stauffer, P. de Tristian, W. Bork and R. M. Lyman.

FRESNO, CAL.—The St. Elmo Oil Company has been incorporated here with a capital stock of $500,000 by R. C. P. Smith, Harry Jackins, G. W. Henderson, J. T. Cleary and B. L. Oliver.

SACRAMENTO, CAL.—The American Canyon Water Company has been incorpora ed here with a capital stock of $1,000,000 by W. O. Bowers, M. A. Nurse, Chas. Cunningham, H. W. Conger, F. L. Atkinson, S. F. McNear, A. L. Darrow, J. H. Buffum, George P. Robinson, H. L. Bissell and R. E. L. Stephens.

LOS ANGELES, CAL.—The Gas Supplies Company has been incorporated here with a capital stock of $20,000 by G. B. Laughlin, M. H. French, I. O. Jacobs, T. C. Powell and C. M. Roberts.

BAKERSFIELD, CAL.—The Twenty-three Oil Company has been incorporated here with a capital stock of $500,000 by H. E. Wright, H. W. Thomas, W. H. Morris, T. M. Young and W. B. Beaizley.

SACRAMENTO, CAL.—The American Irrigation Company has been incorporated here with a capital stock of $250,000 by George P. Robinson, H. A. Buffum, F. L. Atkinson, J. F. Azevedo, O. G. Hopkins, W. F. Gormley and C. A. Haines.

SAN FRANCISCO, CAL.—The stockholders of the United Railways Investment Company have approved the purchase of the Stanislaus Electric Power Company and propose to organize a new company, which will be known as the San Francisco Electric Railways Company, with a capital stock of $10,000,000. This property, which was recently bought at auction for $2,200,000, will furnish the United Railways of this city with 15,000 horsepower. The company announces a number of important surburban improvements, which will include a large part of the peninsula.

ILLUMINATION.

COALINGA, CAL.—A. W. Smith and S. H. Hain have been granted a gas franchise on certain public highways in this city.

SANGER, CAL.—The Sanger Electric Light Company has filed its application for dissolution in the Superior Court of this county.

LOS ANGELES, CAL.—Bids will be received by the Board of Supervisors for a fifty-year gas franchise in certain portions of Los Angeles County.

MODESTO, CAL.—Superintendent Archie Scott and Attorney W. H. Hatton of the La Grande Light & Power Company, have purchased a tract of land here where sub-stations for the company will be erected.

FORT BRAGG, CAL.—The Fort Bragg Electric Light Company has decided to enlarge its electric light plant and will install a 750 k. w. generator and steam turbine during the summer. The company will also erect another transmission line from Fort Bragg to Mendocino to improve the service

OIL.

GRESHAM, CAL.—The Gresham Oil & Developing Company is getting stock on the market and arranging for material for putting down an experimental well.

BAKERSFIELD, CAL.—The Superior Oil Company has declared its eighth dividend of $5000, or 1 cent a share. This makes a total of $10,000 paid to the stockholders in dividends

COALINGA, CAL.—S. W. Morsehead, H. H. Welsh, L. P. St. Clair and M. W. McJuigg, announce plans for a new pipe line to be built soon to carry the production of the independent oil producers of Coalinga and the Kern County field to tidewater.

BAKERSFIELD, CAL.—The Johnson Oil Company, on the Maricopa field, has struck at a depth of 56 feet a production of light oil with abundant gas pressure. The well started flowing at an estimated rate of 500 barrels a day. No sign of water has yet been found and the company will continue drilling.

TRANSMISSION.

DOWNIEVILLE, CAL.—Walter Painter and Homer Gould have located 15,000 inches of water from the North Yuba River, just below this place. The water is to be used to develop electric power for mining purposes.

AZTEC, NEW MEX.—A bill has been introduced into the House providing that the Secretary of Treasury spend $300,000 for the construction of an electrical power plant at Deming, for furnishing power for an irrigation project.

REDDING, CAL.—The Sacramento Valley Power Company has bought the water rights owned by some half dozen pioneer farmers on the North Battle Creek, for $100,000. The company plans using every inch of the water to generate electrical power, thus increasing its output from 3600 horsepower to 15,000 horsepower.

RED BLUFF, CAL.—Two more notices of appropriations of water have been filed with the county recorder. E. W. Stores has filed on 20,000 inches of water to be diverted about 14 miles above the junction of Mill Creek and Little Mill Creek, the water to be used in generating electric power; and W. D. Russel has applied for 500 inches of water from Bennet Creek, to be used in generating electrical power.

PLACERVILLE, CAL.—Jacob Snow has filed here with the county recorder a notice of location and appropriation of 15,000 inches of water flowing in the South Fork of the American river, the water to be taken out just below the lower plant of the American River Electric Company. Mr. Snow will divert the water and conduct it a distance of two miles to a point where a location has been secured for an electric power plant.

WATER.

PIONEER, NEV.—The Pioneer Water Company has secured a water franchise for supplying this city with water from Bryan's Springs.

OAKLAND, CAL.—The Board of Public Works awarded a $34,000 contract to Cotton Bros. for the laying of pipes for the salt water fire protection system.

OAKLAND, CAL.—Bids will be received by the Board of Public Works till June 2, 1909, for furnishing material for the salt water high pressure fire system to be built in this city.

KING CITY, CAL.—Manager Baird of the King City Water, Light & Power Company, was in San Francisco this week purchasing machinery for increasing the capacity of the plant to 200,000 gallons per day.

LOS ANGELES, CAL.—Attorney Cassius Carter has served notice on the Board of Public Works that he will bring suit to prevent the awarding of a $68,000 water-pipe contract to the Western Metal Supply Company on the ground that the city was in error in not advertising for bids.

OAKLAND, CAL.—The management of the People's Water Company has passed into new hands. Four new directors were elected at a meeting held last week, H. C. Capwell, J. Y. Eccleston, L. G. Burpee and A. W. Naylor. The directors who resigned were E. A. Heron, W. F. Kelly, John H. Spring and Louis Titus. The new board, it is announced, proposes to effect a complete reorganization of the company's affairs. Plans have been outlined which will involve considerable expenditure for permanent improvements and development of water sources of supply.

PETALUMA, CAL.—The following bids have been received for furnishing a pumping plant for the salt water fire system in this city: The Corliss Gas Engine Company of Petaluma, 300 horsepower motor and 8 inch pipe, $4,190; the Western Electric Company of San Francisco, $1,540 on motor, $700 on starter and $108 for extras; the Nevada Machinery & Supply Company of San Francisco $3,870 for pump and motor; the Union Iron Works, San Francisco, pumping plant $2,825, motor additional, $1,601; The Byron Jackson Iron Works, San Francisco, $3769 complete; Fairbanks, Morse & Co., San Francisco, induction motor, $1,600; The Krogh Manufacturing Company, $3,875 complete, or $2,275 without the motor; Henry R. Worthington, $2,505 for pumping plant and wrought pipe or $3,980 with motor; Allis-Chambers Company, San Francisco, $4,620 complete; The Westinghouse Company, San Francisco, motor $1,461; The California Hydraulic Engine & Supply Company, San Francieso, $1,635; and Harron, Rickard & McCone, San Francisco, $1,830 complete.

TRANSPORTATION.

MONTEREY, CAL.—H. R. O'Bryen has applied for an electric street railway in the County of Monterey.

SAN BERNARDINO, CAL.—John M. Morris has applied for an electric franchise over certain rights of way in this city.

GARDNERVILLE, NEV.—A. J. Jensen and H. H. Springmeyer have applied for a street railway franchise in this place.

PHOENIX, ARIZ.—The Suburban Railway Company has been granted an electric railway franchise on certain highways in this city.

BERKELEY, CAL.—The Oakland Traction Company announces an extension of its Northbrae electric line to Ocean View in the near future.

UPLAND, CAL.—A. P. Harwood, representing the Pomona and Upland Electric Railway, announces that grading for the new road will begin on June 1st.

TEHAMA, CAL.—Following the application of J. J. Worthington bids will be received in this city for the sale of an electric railway franchise on certain public highways.

VACAVILLE, CAL.—President T. C. Gregory of the Vallejo & Northern Electric Company, has asked for a renewal of the company's franchise in this city. He states that the company has secured the last of its franchises in Sacramento and within 90 days will spend $10,000 in work on their right of way in that city.

OAKLAND, CAL.—Chief Engineer Boggs of the Oakland Traction Company has assured the Board of Public Works that the company would give the city its support in the proposed improvements about Lake Merritt. The traction company has agreed to lay its tracks further apart and keep the boulevard well oiled and paved. It also intends to place the power poles in the center of the street, between the tracks. These poles will be ornamental, with extending arms to carry the power wires and on each pole an electrolier will be placed.

TELEPHONE AND TELEGRAPH.

SALINAS, CAL.—John L. Mathews has been granted permission to erect a telephone line between the Rancho Canada de San Lorenza and King City.

MARYSVILLE, CAL.—It is announced that the Pacific Telephone Company has purchased a site in this city and will erect an office building thereon.

PRESCOTT, ARIZ.—The Arizona Overland Telephone Company has purchased the franchise of Robert Brow, M. Hickey and H. T. Andrews here for a telephone and electric system.

BAKERSFIELD, CAL.—Following the application of the Kern Mutual Telephone Company, bids will be received by the Board of Supervisors up till June 7th, for the sale of a telephone franchise in this city.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer — who will listen with a willing and eager ear to the story of quality.
Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

INDEX TO ADVERTISEMENTS

Wanted and For Sale

The rate for [illegible] $1.00 per insertion for [illegible] words or less; additional words [illegible], payable in advance. Remittance and copy should reach the office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity Power and Gas *60[illegible] Mission Street, San Francisco.*

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.

Journal of Electricity, Power and Gas,
604 Mission Street, San Francisco.

AGENTS WANTED on a guaranteed weekly salary to represent our two publications, "Southern Engineer" and "Southern Machinery", liberal terms for exclusive services; easy sellers; every engineer and every machinist is interested. Write at once. For further information, address W. R. SMITH PUB. CO., Sub. Dept. Atlanta, Georgia.

WANTED—Men coming in direct touch with Steam, Electrical Superintending Engineers and Shop Foremen. A proposition that can be handled by energetic persons to good advantage. Liberal commission and permanent work. CHAS. L TURNER, 907 Atlas Bldg., San Francisco, Cal.

SITUATION WANTED—By electrical engineer with 15 years' experience in designing and estimating of electric power plants, switch gears, light, motor and storage battery installations; also in central station service. Advertiser takes also draughting work in this line as home occupation if no steady engagement can be attained. Moderate expectations. Address Box 101, **Journal of Electricity,** San Francisco.

WANTED—Trustworthy man or woman in each county to advertise, receive orders and manage business for New York Mail Order House. $18.00 weekly; position permanent, no investment required. Previous experience not essential to engaging. Spare time valuable. Enclose self-addressed envelope for full particulars. Address Clark Co., Wholesale Dept., 103 Park Avenue, New York.

Cutter Co., The, "Munit."
Electric Appliance Co., "T. & B."
General Electric Co.
Krantz Mfg. Co., H.
Paiste, H. T. Co.
Pass & Seymour.
Sprague Electric Co., "Universal."
Standard Electrical Works, "M. & M."
Stanley & Patterson, Inc., "Simplex."
Telephone & Elec.Equip.Co. "Pratt Chuck Co."

BRACKETS

Desk Telephone Brackets

Brooks-Follis Elec. Corp.
Stanley & Patterson, Inc., "Imperial."
Sterling Elec. Co., "Equipoise."
Western Electric Co.

Iron Pole Brackets

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Cutter."
Pierson, Roeding & Co.
Western Elec. Co., "Fletcher."

BURNERS

Gas Lighting Burners

Edwards & Co.
Electric Goods Mfg. Co., "Advance."
Western Electric Co., "Edwards."

CABINETS

Special Cabinet Work

Krantz, H., Mfg. Co.

Metal Cabinets

Krantz, H., Mfg. Co.

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Submarine and Lead-Covered

Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
Standard Underground Cable Co.
Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

Paper Insulation

Belden Manufacturing Co.
Western Electric Co.

Telephone Cable

Dean Electric Co.
Kellogg Switchboard and Supply Co.

CARBONS

Arc Light Carbons

Brooks-Follis Elec. Corp. "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The "I-T-E." "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
American Ever Ready Co.
Kierulff, Jr. & Co., B. F. "Hartman."
Pacific Electric & Manufacturing Co.
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLAMPS

Ground Clamps.

Belden Manufacturing Co.
Bossert Electric Const. Co.
Chase - Shawmut Co., "Shawmut."

General Electric Co.
Paiste Co., H. T. "Perma-Effect."
Thomas & Sons Co., R.
Weber Elec. Co., H. D.

CLEATS.

Fibre Cleats

Blake Signal & Mfg. Co.
Brooks-Follis Elec. Corp.

Porcelain Cleats

Brooks-Follis Elec. Corp.
General Electric Co.
Pass & Seymour
Standard Electrical Works, "Standard."
Star Porcelain Co.
Sears, general sales agent.
Western Elec. Co., "Thomas."

COILS

Armature and Field Coils

Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Deltabeston."
Westghse Elec. & Mfg. Co.

Induction Coils

Electric Goods Mfg. Co.
Kellogg Switchboard and Supply Co.
Partrick,Carter&WilkinsCo.
Western Electric Co.

Spark Coils

Electric Goods Mfg. Co.
Western Electric Co.

COMPOUNDS

Boiler Compounds

Dearborn Drug & Chemical Works
Johns-Manville Co., H. W., "Magic."

CONDUIT

Flexible Conduit

American Circular Loom Co., "Circular Loom."
Sprague Electric Co., "Greenfield."
Telephone & Elec.Equip.Co. "Flexduct."

Rigid Conduit

American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct," "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roebling's Sons Co., J. A., "Navalite."
Sprague Electric Co., "Iron Armored."
Telephone & Elec.Equip.Co. "Economy."

Underground Conduit

American Cross Arm Co., "Walworth & Neville."
Johns-Manville Co., H. W., "J-M."
Pierson, Roeding & Co., "Fibre."
Roebling's Sons Co., J. A., "Bituminized Fiber."
Western Electric Co. "Walworth & Neville."

CONNECTORS

Cable Connectors

American Ever Ready Co. "Bulldog."
Belden Manufacturing Co.
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F., Jr. & Co..

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Flexible Bell Cord

Belden Mfg. Co.
Brooks-Follis Elec. Corp.
General Electric Co.
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Roebling's Sons Co., J. A.
Simplex Elec. Co.
Western Electric Co.

Lamp Cord

Belden Mfg. Co.
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "Paranite."

General Electric Co.
Okonite Co., The, "Okonite."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Roebling's Sons Co., John A.
Safety Ins. Wire and Cable Co.
Simplex Elec. Co.
Standard Und. Cable Co.
Western Elec. Co., "Victor."

Telephone Cord.

Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Dean Electric Co.
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Safety Ins. Wire and Cable Co.
Simplex Elec. Co.
Western Elec. Co., "Victor."

CROSS ARM BRACES.

Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co.

CLUSTERS

Fixture Clusters

Benjamin Electric Mfg. Co. "Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbell."

CUT-OUTS

Arc Cut-Outs

Bryant Electric Co.
Ft. Wayne Elec. Works.
General Electric Co.

Incandescent Cut-Outs

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
Paiste Co., H. T., "Shaffer," "K. W.," "P. K.," "Taplets."
Perkins Elec. Swch Mfg Co.
Weber Elec. Co., H. D. Sears, general sales agent.
Westghse Elec. & Mfg. Co.

Transformer Cut-Outs

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour
Westghse Elec. & Mfg. Co.

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A. C. Dynamos

Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

D. C. Dynamos

Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

ELECTRIC NOVELTIES

American Ever Ready Co "Ever Ready."

ENGINES

Gas and Gasoline Engines

Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Kierulff, B. F., Jr. & Co., "American Diesel."
Tracy Engineering Co.
Westinghouse Machine Co.

Marine Engines

Standard Engineering Co., "Engberg."

Steam Engines

Moore & Co., Chas. C.
Henshaw, Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Standard Engineering Co.
Tracy Engineering Co., The
Westinghouse Machine Co.

FANS

A. C. Portable Fans
Brooks-Follis Elec. Corp.
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Standard Electric Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

D. C. Portable Fans
Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Sprague Electric Co., "Lundell."
Standard Electrical Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

A. C. Ceiling Fans
Brooks-Follis Elec. Corp.
Standard Elec. Works, "Jandus," "Century."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

D. C. Ceiling Fans
Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
General Electric Co.
Sprague Electric Co., "Lundell."
Standard Elec. Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

Exhaust Fans
Brooks-Follis Elec. Corp.
General Electric Co.
Standard Elec. Wks., "M. A. Co."
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co.

FIXTURES

Ceiling, Bracket and Desk Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.

Marine Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.
Electric Appliance Co.
Sterling Electric Co.

Show Case Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.
Johns-Manville Co., H. W., "Linolite."

Stage Fixtures
Chase-Shawmut Co.,"Shawmut,"

FLASHLIGHT (Pocket)

American Eveready Co., "Ever Ready."

FUSE MATERIAL

Enclosed Fuses and Fittings
Bryant Electric Co.
Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co., "Union."
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W., "Noark."
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

Fuse Boxes
Including Service Boxes, Subway Boxes and Junction Cut-Outs for use with enclosed fuses.
D. & W. Fuse Co., "D. & W.'
Johns-Manville Co., H. W., "Noark."

Fuse Wire and Links.
Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co.
General Electric Co.
Pierson, Roeding & Co., "Aluminum."

Miscellaneous Fuses
Bryant Electric Co.
General Electric Co.

Paiste, H. T. Co., "H. & L.
Weber Elec. Co., H. I
Sears, Gen'l Sales Agent

Telephone Fuses

Dean Electric Co.
D. & W. Fuse Co.
Kierulff, B. F., Jr. & Co
"Sterling."
Standard Elec. Works
"Couch & Seeley."
Western Electric Co.

GOVERNORS.

Water-Wheel Governors

Pierson, Roeding & Co
"Lombard."

GUARDS.

Wire Lamp Guards.

Benjamin Electric Mfg. Co
"Can't Break," "Protec
talite."
Hubbell, Harvey
Krantz, H., Mfg. Co.

HANGERS

Cable Hangers

Chase-Shawmut Co., "Bos
ton."
Kierulff, B. F. Jr. & Co
"National."
Standard Underground Ca
ble Co., "Nordyke Sup
port."

HEATING MATERIAL.

Including Cooking Utensil
Soldering Irons, Sa
Irons, Etc.
Brooks-Follis Elec. Corp.
Elec. Appliance Co. "Amer
ican."
General Electric Co.
Johns-Manville Co., H. W
"Electrotherm."
Simplex Elec. Heating Co
"Simplex."
Vulcan Elec. Heating Co
"Vulcan."
Westghse Elec. & Mfg. Co

HOODS.

Street Hoods

Elec. Appliance Co., "Cut
tér."
Ft. Wayne Elec. Works.
General Electric Co.
Kierulff, B. F., Jr. & Co
"Cutter."
Western Elec. Co., "Fletch
er."

INSULATORS

Glass Insulators

Brookfield Glass Company
"Brookfield."
Elec. Appliance Co., "Hem
ingray."
Pierson, Roeding & Co
"Locke Triple Petticoat.
Roebling's Sons Co., Joh
A., "Knowles."
Standard Electrical Work
"Standard."
Western Elec. Co., "Brook
field."

High-Tension Insulators.

General Electric Co.
Johns-Manville Co., H. W
Kierulff, B. F., Jr. & Co
"Ohio Brass."
Pass & Seymour.
Pierson, Roeding & Co
"Locke."
Roebling's Sons Co., Joh
A., "Lima."
Thomas & Sons Co., R.
Western Elec. Co., "Thom
as."

Porcelain Insulators

General Electric Co.
Johns-Manville Co., H. W
Pass & Seymour
Pierson, Roeding & Co
"Locke."
Standard Electrical Work
"Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Electric Co., H. I
Sears, gen'l sales agen
Western Elec. Co., "Thom
as."

Wood Knobs

Blake Signal & Mfg. Co.

INSULATING MATERIA

Belden Manufacturing Co
Brooks-Follis Elec. Corp
Kierulff, B. F., Jr. & Co
"Di-electric."

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POWER AND GAS

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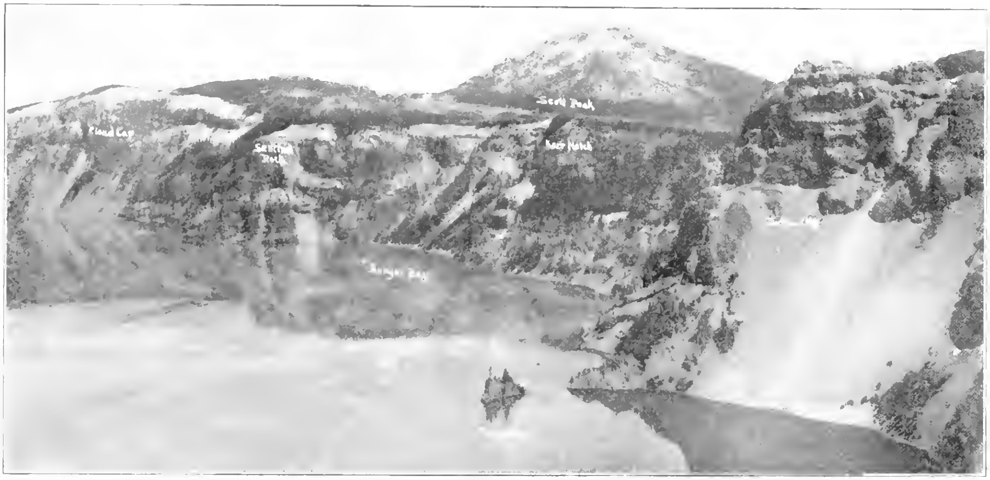


Crater Lake, Oregon, Showing Phantom Ship.

ELECTRICITY IN THE ROGUE RIVER VALLEY.

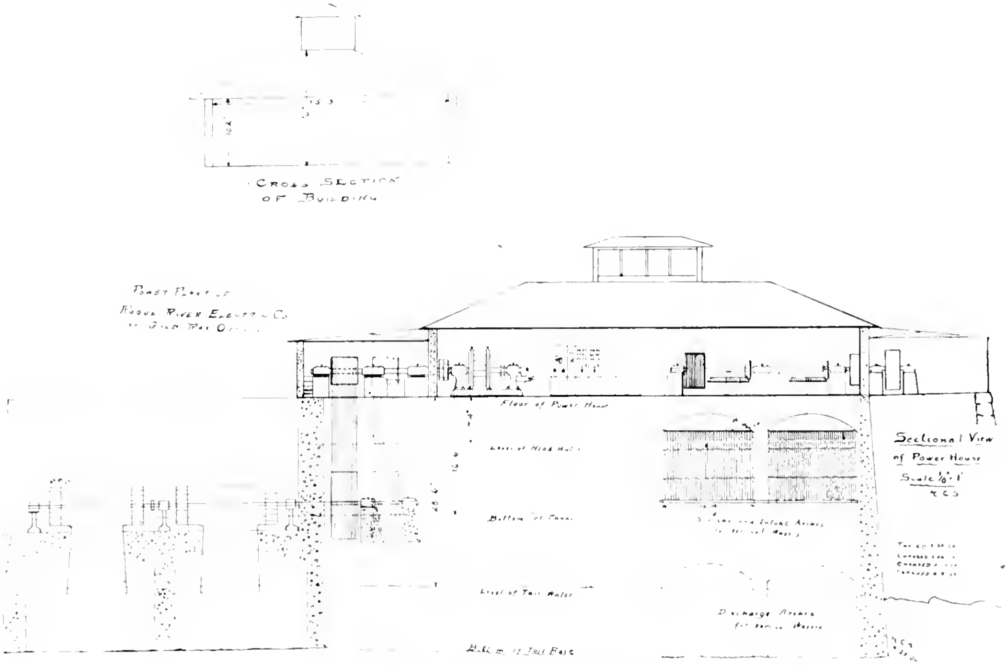
BY ARTHUR H. HALLORAN.

Jumping Salmon.

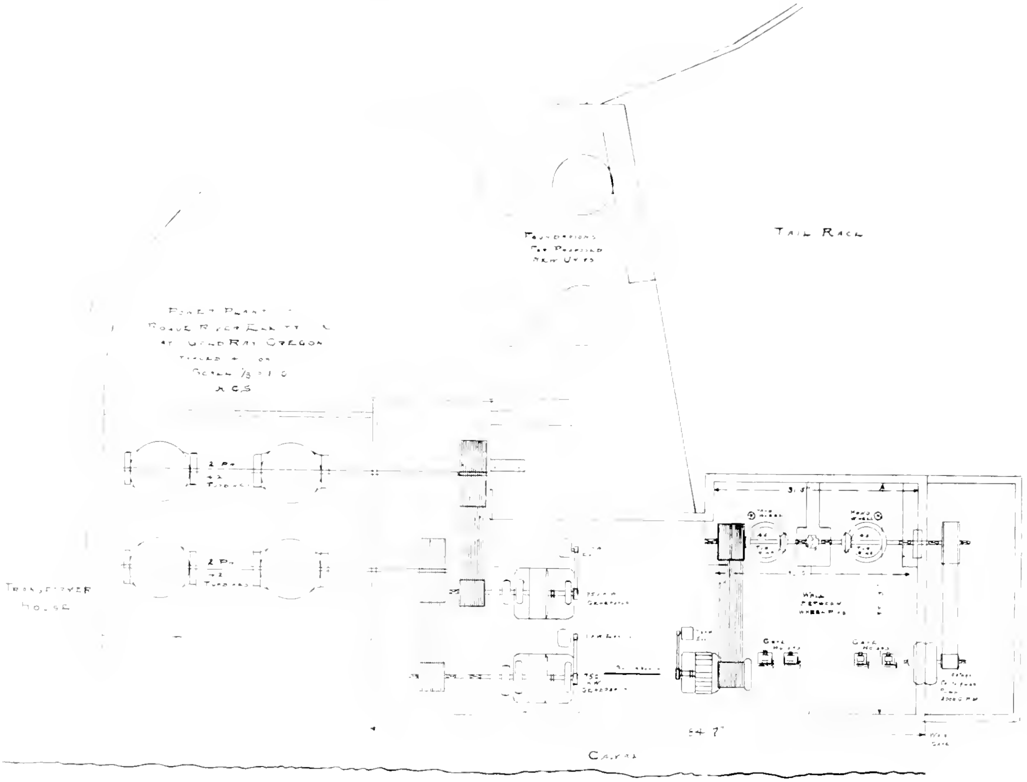
OREGON suggests apples—great, juicy, crisp, red apples. The finest of them come from the valley of the Rogue River, whose tumbling torrent heads in the high Cascades close to the blue placid waters of Crater Lake, that wierd body with its phantom ship which reincarnates the skeleton of Mazama's ancient volcano. The contrast wrought by time in quenching the misdirected energy of this youthful giant has been duplicated on a smaller scale in the history of this valley whose exuberant spirits in "the days of old, the days of gold," have been succeeded by the steady progressive spirit of horticultural success.

Gold was the lure spread by Nature to attract the hardy pioneer of the fifty's. Many stayed to enjoy the more lasting and more productive results of developing the soil. Blessed with all the bounties of Nature, a beneficent climate, a fertile soil, and beautiful scenery, this valley is already supporting 25,000 people, "and not half trying." "Apple and peach trees, fruited deep," are flanked by luscious pears, plums and cherries, with increasing acreage to vineyards. This fruit, because of fine flavor and excellent keeping qualities, commands the highest market price, so that the yearly profit often exceeds one thousand dollars per acre.

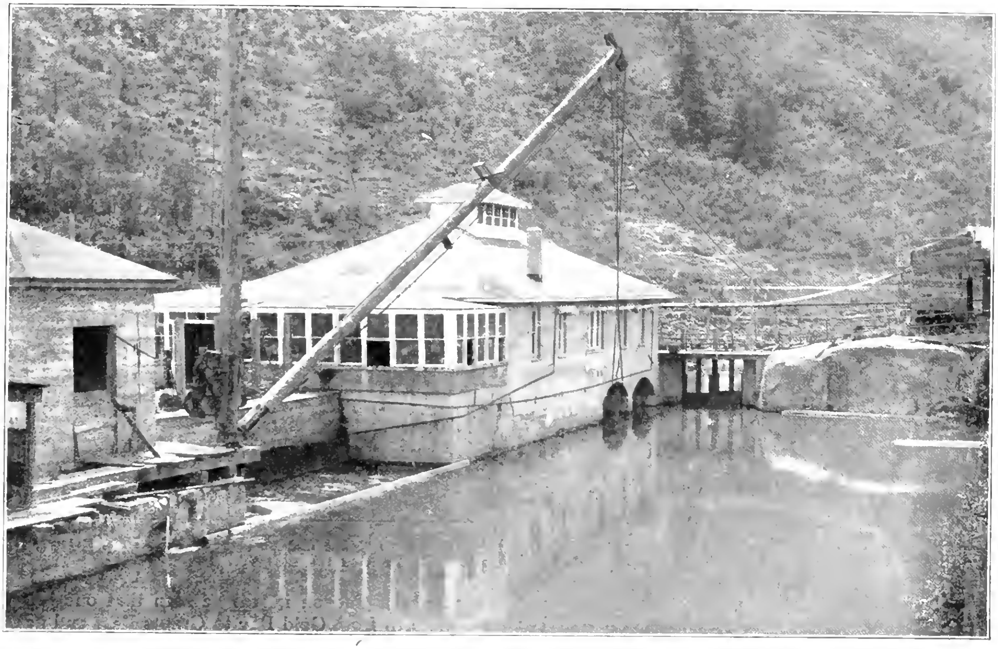
All this has been accomplished without the helping hand of irrigation, except where attention has been turned to raising melons, corn and alfalfa. The far-sighted are just realizing the wonderful possibilities of undeveloped water resources to further increase crop production. An unfailing supply of water can be pumped from wells 20 to 30 feet deep and surrounding streams, and here it is that the greatest use is to be found for the abundant hydro-electric power being generated by the Rogue River Electric Company. For eighty miles up and down the valley a net-work of wires bring the power to the work



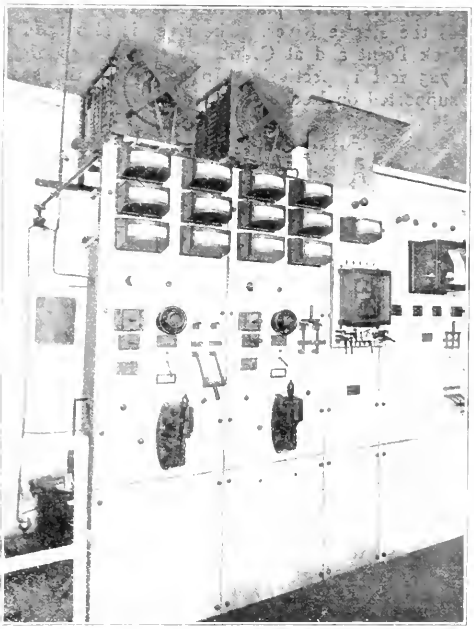
Sectional View of Power House.



Plan of Power House.



Fore Bay, Power House and Transformer House, Rogue River Electric Company.

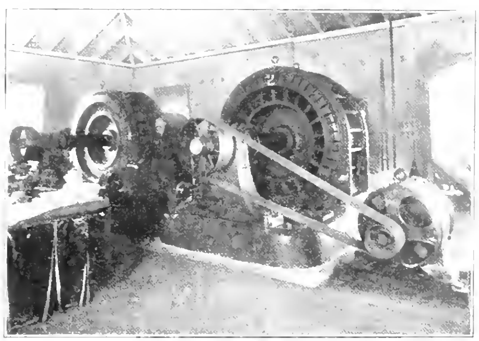


Switchboard.

equipped with three ammeters, a watt meter, a volt meter, and field ammeter, as well as field and disconnecting switches, synchronizing plugs and control k. w., or over 2,600 horsepower. Provision has been made for two additional generators as soon as the current consumption warrants.

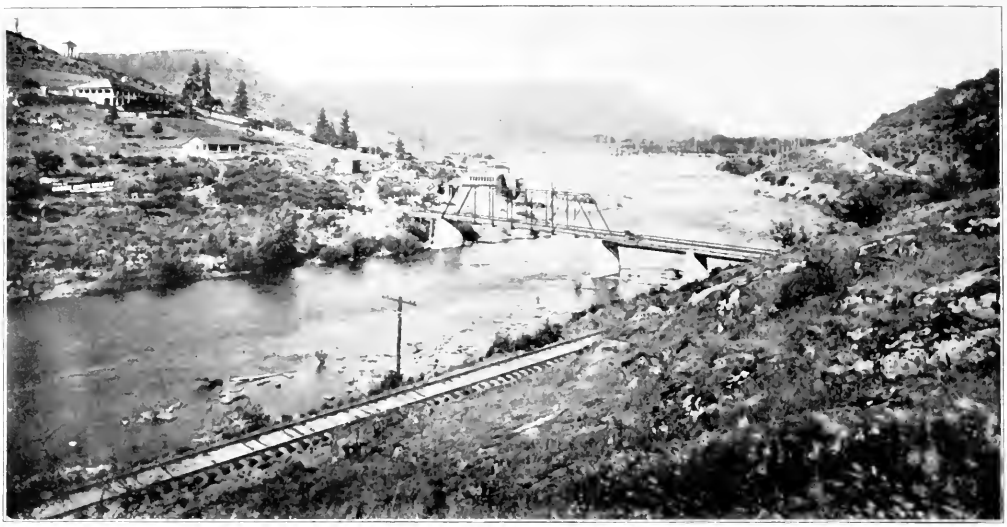
The switchboard consists of three machine panels and an exciter panel. Each of the machine panels is switches for the Lombard governors. On the exciter panel are mounted the exciter switches, volt meter, Tirrill regulator and curve-drawing volt meter, together with pilot and synchronizing lamps and a synchronizing bracket at the end of the board. All these instruments and apparatus were made by the General Electric Company.

The switchboard and all machinery are so arranged that the station operator's desk commands a



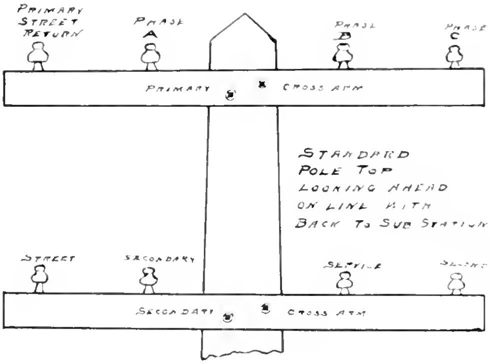
Two 750 kw. Generators.

view of practically the entire power plant. This has an important economic bearing, for except during periods of heavy load, when the machines are to be paralleled, the entire station is operated by one man. From the switchboards two lines of lead-covered No. 0000 copper cables run to the transformer house.



Panorama at Gold Bay, Oregon, Showing Power Plant, Dam, Bridge, Club House and Employees' Residence, Belonging to the Rogue River Electric Company. Table Rock in the Distance.

This contains six 250 k. w., 2,300 to 22,500 volt step-up transformers, oil insulated and water cooled. The cooling water is furnished from a water system which supplies the various buildings and residences on the works. There is also a small two-inch centrifugal pump which can be used to supply cooling water direct to the transformers in event of accident to the usual system.

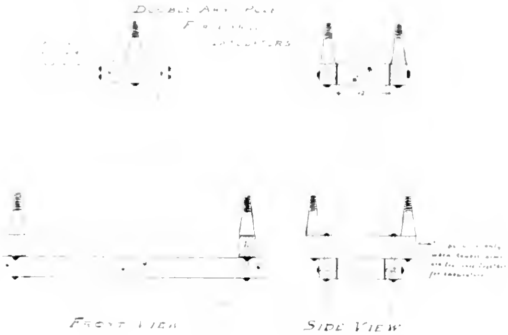


Standard Pole Top Construction.

TRANSMISSION.

From this plant a 22,500 volt transmission line extends for a total length of eighty miles to the several sub-stations. No. 1 7-strand aluminum wire is used throughout the transmission system. In the course of five years' operation there has been no shut down due to trouble with the aluminum wire or the insulators. The three wires are spaced in a 48-inch triangle on the top of 40-foot cedar poles placed forty to the mile. The insulators are of porcelain, 10 and 11 inches, petticoat type and are fastened to the poles by means of eucalyptus pins. Referring to the map of Southern Oregon it will be seen that one line extends north from Gold Bay to Grants Pass and nearby mines, while the other extends south to Ashland through Medford and intermediate towns.

From the power plant there is a 675-foot span across the Rogue River. The river is also spanned at Rock Point and at Grants Pass, distances of 600 and 725 feet respectively. In each case the spans are supported on Locke strain insulators mounted on



Double Arm Pole for Large Insulators.

wooden towers consisting of four cedar poles placed 14 feet apart.

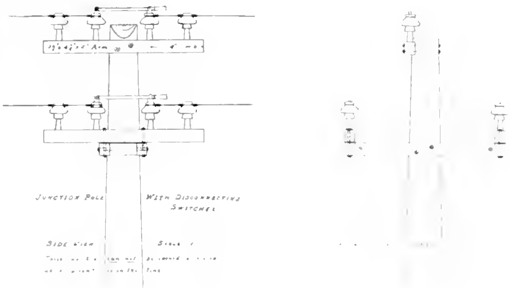
DISTRIBUTION.

Sub-stations are located at Central Point, Jacksonville, Medford, Gold Hill, Grants Pass, Ashland and Tallant. At the last two stations power is sold at wholesale to a sub-contractor owning the distributing lines and handling the retail business. In all the other localities the Rogue River Electric Company distributes and sells the current.

The standard sub-station equipment consists of three G. E. type H oil-cooled transformers equipped

with oil switch and ammeter on the 2,200-volt side, this being the distributing voltage. Protection is provided by a bank of General Electric 20,000-volt multigap lightning arresters and line disconnecting switches. Galvanized iron buildings house all this equipment. These sub-stations have required but little attention and are often left locked for a month at a time.

Current is distributed at 2,200 volts up to five miles from the sub-stations, extending into the country so that many ranchers can use it for lighting,

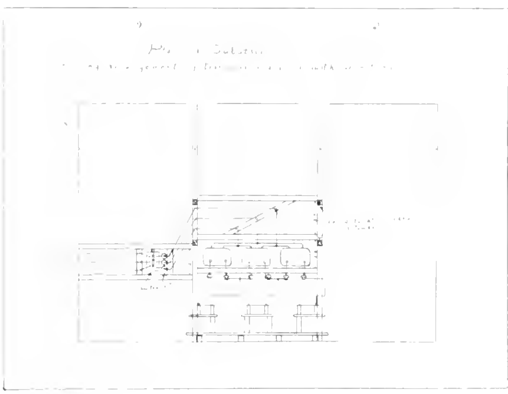


Junction Pole of Sub-Station.

pumping, sawing wood, grinding feed, etc. The power circuits are 440 volts and the lighting 110 volts, reduction being made by pole transformers.

UTILIZATION.

Nearly all power is sold on the meter basis, there being a minimum rate of $1.00 with a 25-cent meter charge. A sliding scale provides 20 kilowatts or less at 10 cents, and 2,000 kilowatts or more at 4 cents, with corresponding intermediate rates. It is stated that



Plan of Sub-Station.

almost without exception electricity is consumed for some purpose other than lighting. The company sells supplies and co-operates with the consumer in every way to give maximum results at minimum cost. Full directions are given customers so that they may check their bills. This includes an interesting summary of what 5 cents worth of electricity will do:

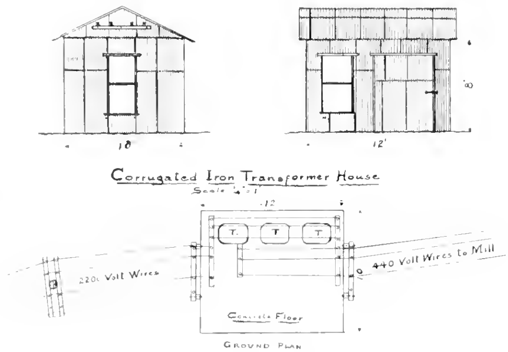
It will warm a woman's curling iron every day in the year for 3 minutes and twice on Sunday.

It will warm a man's shaving water every morning for a month.

It will fry four eggs every morning for a month.

It will boil four eggs every morning for one-half month.

It will warm your bed and prevent cold feet.



Corrugated Iron Transformer House.

It will brew the morning coffee in an average household for more than two weeks.

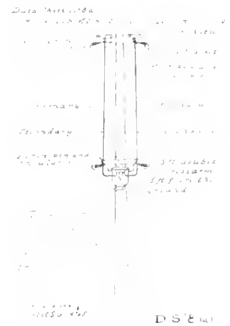
It will run a sewing machine for 21 hours.

It will do the average family ironing.

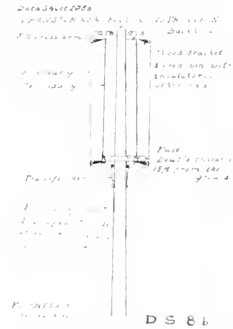
It will pump 900 gallons of water.

It will light 5 16-candle power lamps over two hours in one evening.

Of the 500 consumers in the town of Medford over 250 have electric irons. Many electric heating

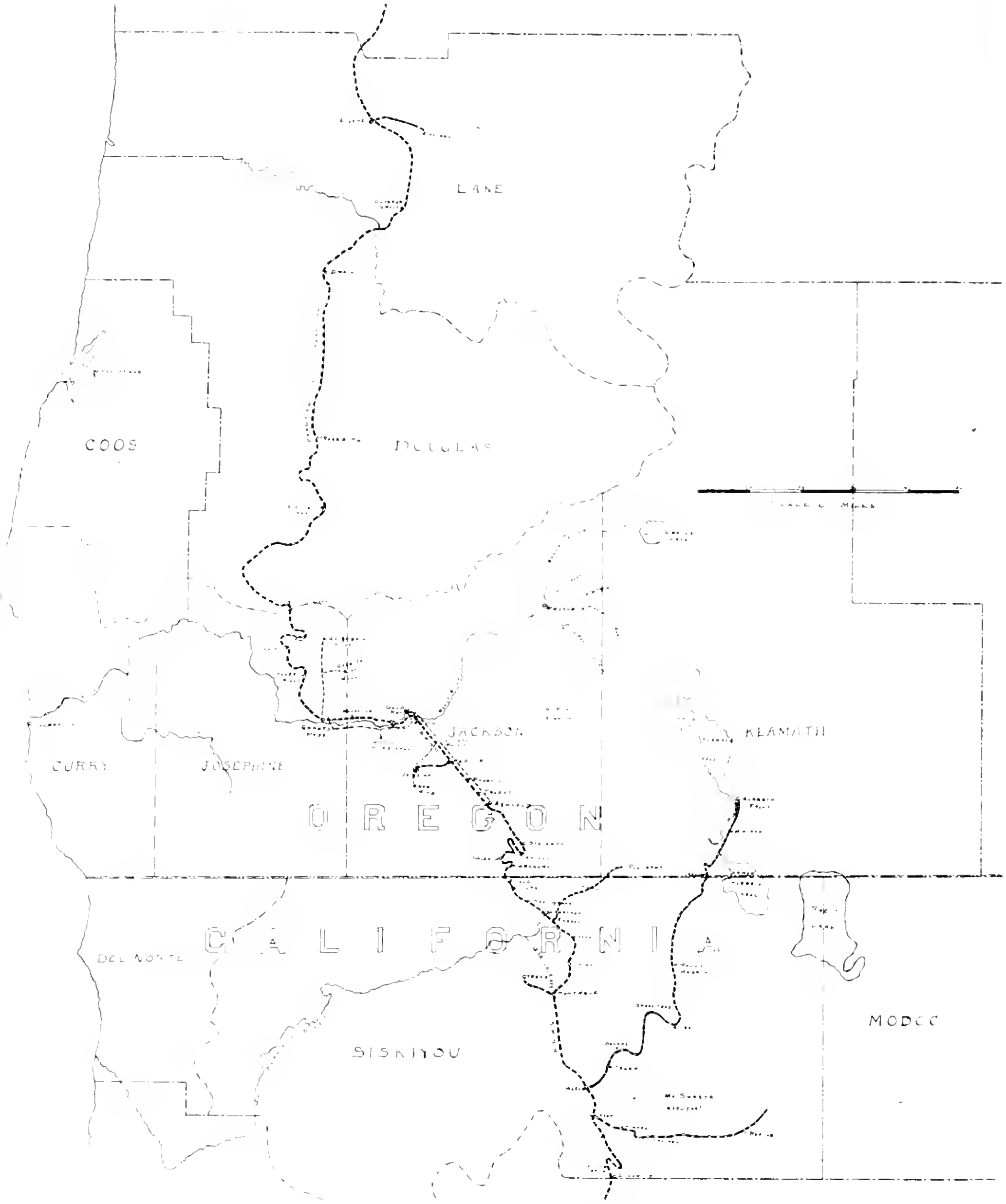


Front View.
Transformer Pole Construction.



Rear View.
Transformer Pole Construction.

devices are in use and much manual labor is saved by small motor installations. Electric power is also furnished to the Champlin gold dredge at Foot's Creek, near Gold Hill, which has been in successful operation for over four years and take 300 horsepower. It is claimed that with electric power gravel running 20 cents per cubic yard can be worked at a profit and that the cost is one-half the former expense when working with wood for fuel. The Braden mine



Map of Southern Oregon and Northern California Showing Transmission Lines of Rogue River Electric Company.

Public Park at Medford, Oregon.

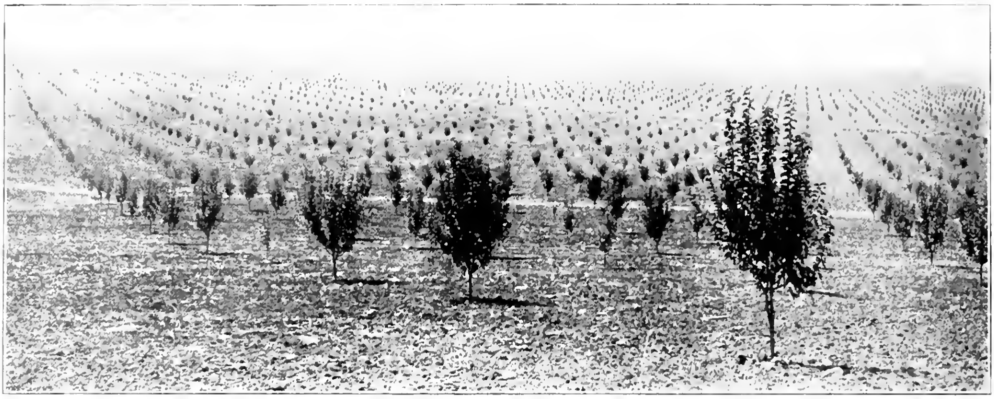
and 10-stamp mill at Gold Hill takes 175 horsepower and the Opp mine at Jacksonville 200 horsepower. A dipper dredge operated by the Electric Gold Dredging Company consumes 150 horsepower. Other mines such as the Greenback and Enterprise use considerable power when operating. Electric power has made possible the working of some mines that did not pay expenses when using wood as fuel.

Quartz Mill at Braden Mine.

Should development of the Blue Ledge Copper Mines, 35 miles southwest of Medford, warrant the construction of a smelter, it will require from 1,500 to 2,000 horsepower for operation.

View of Transmission Line.

The history of almost all Western mining camps



Young Orchard Belonging to Orchard Home, Tolo, Oregon. Water for Irrigation Pumped Through 12-Inch Pipe Line From Power Plant of Rogue River Electric Company.

shows that many producing mines are overlooked in the first rush for gold. Jacksonville, five miles from Medford, was the scene of Oregon's first mining excitement in 1851, and since that time has been a

Main Street, Medford, Oregon.

[illegible] producer by placer, hydraulic and quartz [illegible] an aggregate production of over $20,- [illegible] There are also many undeveloped prospects [illegible] country tributary to the Rogue River valley and with their operation will ensue a further demand for electric power.

The three most thriving towns in the valley are Medford, Ashland and Grants Pass, as can be judged from the accompanying street scenes. Inclosed arcs light the principal streets and incandescent lamps are used in almost all the residences. The company has pushed the sale of tungsten lamps, thus lowering the peak load and keeping within transformer capacity as well as giving satisfaction to the consumers. The rich agricultural and mining districts adjoining these towns are the substantial basis upon which has been

built an enduring prosperity. The equable climate has attracted a most desirable population whose permanency is insured by excellent social and educational facilities.

Southern Oregon Sugar Pine, 29 Feet in Circumference.

The general prosperity is indicated by the fact that there are over one hundred and fifty automobiles in the single town of Medford. The bank deposits per capita are stated to be higher than in any other

Sterling Hydraulic Mine Near Medford, Oregon.

section of the country, this strength being evidenced in the financial flurry of 1907 when the banks in the Rogue River Valley paid cash on demand to all depositors.

But the great, and as yet undeveloped field for power consumption lies in the application of electricity to pumping water for irrigation. Thousands of acres of the most fertile land requires but the quickening touch of dependable water to spring into bloom. Heretofore the four months' dry season has sometimes prevented the best results, especially when it has been demonstrated that crops can be doubled and even quadrupled with the aid of irrigation. An inexhaustible supply of water stands from 10 to 50 feet below the surface and electric power for pumping costs only $30 per horsepower for the irrigating season, which gives an average cost of $1.25 per acre for the season.

In the past four years the Rogue River Electric Company, under the progressive administration of Dr. C. R. Ray, president and general manager, and Mr. H. C. Stoddard, secretary and superintendent, has become an integral part of one of the most prosperous communities in the West. The company controls ample power for any possible future demand from the agricultural, mining, lumbering and industrial interests of the rapidly growing section.

OWNERSHIP OF TELEGRAPH AND TELEPHONE LINES ON THE ISTHMUS OF PANAMA.

At a meeting of the Isthmian Canal Commission at Culebra on April 24th, the chairman presented the report submitted by the committee appointed to consider all questions connected with the ownership, operation and maintenance of the telegraph and telephone lines belonging to the Isthmian Canal Commission and the Panama Railroad Company. In accordance with the recommendation made by the committee, the following agreement between the Isthmian Canal Commission and the Panama Railroad Company was approved:

On and after May 1, 1909, the Panama Railroad Company will construct, maintain and operate all telegraph and telephone lines and equipment that may be needed in the work of the said company and of the Isthmian Canal Commission; that said company will furnish to the Isthmian Canal Commission all such telegraph and telephone service and facilities as the Commission may require, and as may be requested by officers of the Commission with the approval of the chairman and the chief engineer.

In consideration of this agreement on the part of the Panama Railroad Company, the Commission agrees to pay to said company, monthly, an amount equal to seven and a half dollars for each telephone instrument used during the preceding month or fraction thereof, and the Commission further agrees that the Panama Railroad Company shall on and after May 1, 1909, have the use without charge, of the Commission's part of the telegraph and telephone plant and equipment then owned by the Commission, and shall not be liable for deterioration or necessary changes or destruction thereof; and that on the termination of this agreement the railroad company shall pay to the Commission the value at that time, then to be agreed on, of the Commission's interest on May 1, 1909, in the plant and equipment which is turned over to the company on said date.

The Commission also agrees to pay to the railroad company the sum of $2400 per month in full payment for all services rendered by the company in maintaining extra operators, signalmen, and other employes made necessary by the operation of I. C. C. trains over the railroad company's tracks. The Commission will pay telegraph operators in its own offices as heretofore.

THE REAL PURPOSE OF THE AIR BRAKE.[1]

BY W. S. BARTHOLEMEW.

PART III.

On Plate 18 is shown the diagrams of all the stops from the different speeds and brake pipe reductions, and it will be seen that from 30 miles per hour, the stop was made in 1,700 feet with a 5-pound reduction with the improved "K" triple valves, as I have heretofore explained to you, and that to secure a similar stop with old style "H" equipment, it was necessary to make a 20-pound brake pipe reduction, and even then the stop was accomplished in but 1,725 feet.

You will appreciate that it is much easier to recharge the auxiliary reservoirs when but 5 pounds has been deducted in making a stop, as compared with the re-charge when 20 pounds has been required to make the stop or control the train. This accounts for much when handling heavy tonnage trains on grades in excess of 1½ per cent, and from the fact that trains can be controlled with such light applications with "K" triple valves comes one of the most important benefits of the improved equipment. I will show you a little later what can be accomplished in the control of trains on grades when I explain the records of demonstration as illustrated on Plate 20.

Before doing so, however, I wish to explain to you one other very important improvement in the "K" triple valve which I have not mentioned here-

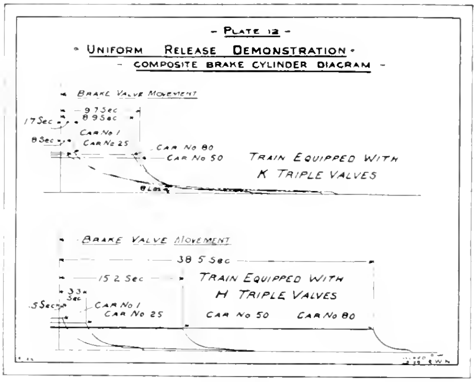


Plate 12.

tofore, as I have confined my talk up to this time to the features having to do with the application of the brakes. On Plate 12 is shown the comparative results of releasing the brakes in long trains with old style and the improved equipment. I have explained to you earlier in the talk that we knew there were shortcomings in the air brake equipment, but that, owing to the engineering difficulties involved, it was necessary to permit them to exist where unimportant, and in any event, that they were shortcomings on the release side, and that, while we might have what the train men called "stuck brakes," it was of much less importance than to have any possibility of non-application of brakes when an application was attempted. I have explained to you the results of the slack running in from the rear end of the train, due to the application of the brakes first on the head end, and, of course, just the opposite to this would be the slack running out on the head end by having the brakes released on the head cars while they were still applied on the rear end. When we now release the brakes in an 80-car train the last car does not start to release for from 11 to 10 seconds after the brakes are released on the head end, as will be seen by referring to the diagram on the bottom part of Plate 12, which illustrates the condition of brake cylinder pressure throughout the train during release and explains why the Southern Pacific, and practically every other railroad, have instructions to engineers which read something like this: After having made a brake application and the speed of train has been reduced to below 10 miles per hour do not release brakes until after the train stops. This is on account of the fact that, if the brakes were released the slack on the head end would run out, as would be indicated by the diagram, and the train probably break in two back of about the twentieth car, and the brakes on the rear end would still be fully applied.

In marked contrast to this is the diagram shown on top of Plate 12, which illustrates that, while the brakes on the head end start to release at about the same time with the improved equipment, as shown on the bottom of the plate with the old equipment, the brake cylinder pressure is not permitted to escape until the brakes on the rear end have started to release and the pressure in the rear brake cylinders has been reduced to a point where all of the brakes in the train would be releasing together uniformly. This action of the improved equipment will permit the release of brakes on freight trains at any time desired. There are many benefits which will result from this improvement. The principal one, of course, would be the reduction to shocks internally in the train, which is, of course, the primary object we are after; and the next most important would be the great saving in time, as, if a freight train could slow up and pull in on a siding, instead of completing the stop, as at present, considerable saving in time could be made each time it was necessary to head in for passing trains. This improvement we have named the "uniform release" feature, and is brought about by the triple valves, which happen to be in the head end of the train, restricting the exhaust passages by utilizing the greater differential there is in the brake pipe on the head end during release of brakes to operate the uniform release feature so that the air does not escape out of the front brake cylinders as rapidly as from those farther back in the train which have the exhaust ports fully opened.

On roads where the trains are fully equipped they will be able to withdraw the instructions to complete the stop; and I think I am safe in saying that this one feature would save the Southern Pacific company more money than any other feature; in fact, Mr. Scott and Mr. Kruttschnitt of the Southern Pacific company place it as the most important one.

On Plate 20 is shown the record of a demonstration made on Beaumont grade from Beaumont to Palm Springs, Cal., and illustrates how the improvements

[1] Part III completes Mr. Bartholemew's article on "The Real Purpose of the Air Brake," a paper read before the San Francisco section of the American Institute of Electrical Engineers, November 27th, 1908. Part I appeared in our issue of May 22nd and Part II in our issue of May 29th.

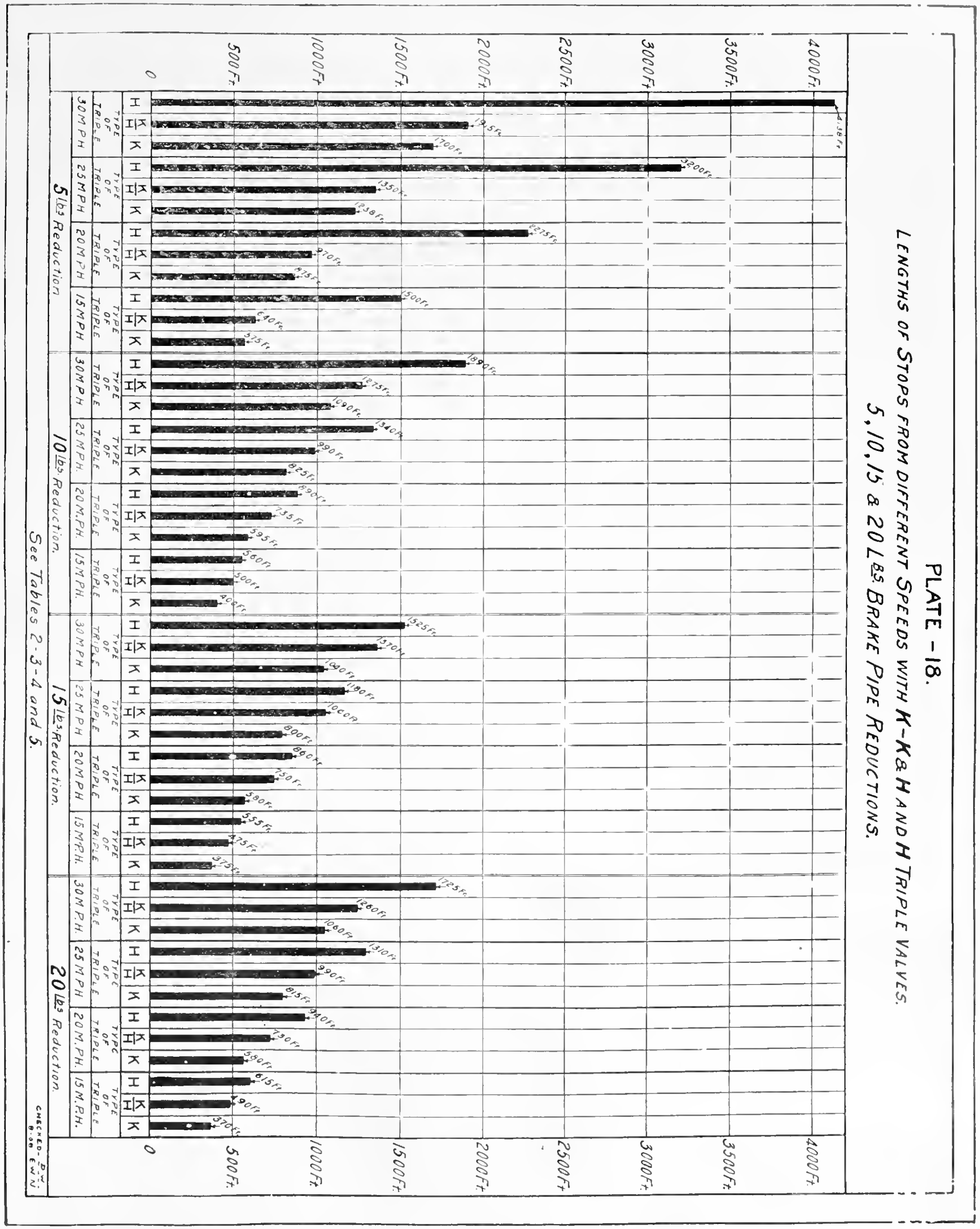


PLATE - 18.
LENGTHS OF STOPS FROM DIFFERENT SPEEDS WITH K-K & H AND H TRIPLE VALVES.
5, 10, 15 & 20 LBS. BRAKE PIPE REDUCTIONS.
0
500 Ft.
1000 Ft.
1500 Ft.
2000 Ft.
2500 Ft.
3000 Ft.
3500 Ft.
4000 Ft.
5 lbs. Reduction
10 lbs. Reduction.
15 lbs. Reduction.
20 lbs. Reduction.
30 M.P.H.
25 M.P.H.
20 M.P.H.
15 M.P.H.
TYPE OF TRIPLE
H
H/K
K
See Tables 2-3-4 and 5.

in the new triple valve can be reduced to dollars and cents. This chart shows the use of the equipment in handling tonnage, which, as I stated earlier in the evening, is the primary reason for the application of air brakes to freight trains today. The Southern Pacific company, and, by the way, they are almost unique in that, have a very sane and safe train and tonnage limit on all of their grades. The average person, and perhaps you all think that the tonnage which can be hauled up hill would be what limited the carrying capacity of a single track division, but it is not; it is the tonnage that we can control down hill which sets the limit.

This particular grade, which is from Beaumont to Palm Springs in Southern California, being the slope down into the Salton Basin, is about 20 miles long and nearly 2 per cent gradient the entire distance, with only moderate curvature. Reading from the bottom of the chart up are shown the mile posts, the curvature of the track, profile from Beaumont to Palm Springs with per cent of gradient at frequent intervals, speed of train in miles per hour, time brakes were applied and released, brake cylinder pressure on last car, amount in pounds of each brake pipe reduction, serial number for identification of each brake application, auxiliary reservoir pressure on last car, main reservoir pressure, the present rating by the Southern Pacific company of this grade, the tonnage handled in this demonstration in the different zones, and the time each mile post was passed.

The tonnage rating for this grade is a maximum of 4,000 M's for the weight of the train back of the locomotive and this tonnage must be distributed so that each operative brake shall not be required to control more than 110 M's.

This chart has been arranged particularly to permit observation comparatively of the points brought out in the demonstration, which, in the order of their importance, are the total tonnage handled in the different zones, the M's per brake, the maintenance of the auxiliary reservoir pressures throughout the run, the light average brake pipe reductions needed to control the train and the perfect control of train as indicated by the speed diagram near the bottom of the chart. It will be seen that the brakes were off more than they were on, and at no time was there an indication of using any of the ample reserved stored volume. This run had been preceded, of course, by other runs in which the normal tonnage had been handled to determine what safety reserve there was in the improved equipment when handling normal tonnage, so that this run was started with a maximum tonnage of 167.5 M's per good brake, and when it was discovered that the train could be controlled with light applications even with this high average, the tonnage was increased to 177.5 M's per good brake by cutting out some of the operative brakes, and during the latter part of the run the tonnage was still further increased to 182.8 M's per good brake, being the maximum handled, and it will be noted that the auxiliary reservoir pressure maintenance was still normal, with the speed of train not exceeding 16 miles per hour on the straightest part of the grade from which no benefit was secured in retardation from wheel flanging.

It was not necessary, of course, to handle such excessive tonnage in M's per brake, but as the Southern Pacific company has oil cars, which, when loaded, weigh 150 M's each, it was desired to demonstrate the fact that solid oil trains could be handled even with some defective air brake equipment which might naturally occur in daily service, which, of course, might make it necessary to handle similar tonnage in M's per brake to that used in this demonstration.

The control of the train at the speeds indicated, and with the normally light brake applications and with brakes applied less than 40 per cent of the time, satisfactorily indicates the great benefits which come from the complete serial action of the brakes from light applications occurring throughout the train in less than one-half the time and with more uniformity than with old style equipment.

Heretofore, the front brakes in the train have been required to do most of the work, causing excessive wheel heating; whereas, in the demonstration illustrated in Plate 20, the wheel heating was very uniform throughout on account of the even distribution of the braking effort, as might be expected from what I have explained to you as being shown in the other diagrams earlier in the evening.

The fact that tonnage can be handled on such grades as Beaumont hill, of 182.8 M's per good brake, as against the standard rating of 110 M's per brake, illustrates how air brake improvements can be reduced by the railroad companies to actual monetary considerations, without regard to the value in other respects of the improved factor of safety.

I wish to say, also, that the Westinghouse Air Brake company and other companies have been accused many times of endeavoring to influence legislation in regard to safety appliances, but I think I have made it quite clear this evening that operating conditions are usually ahead of the development of the air brake apparatus and that, instead of being apt to influence legislation, we would more naturally be on the other side of the question, as any rulings of the interstate commerce commission which requires more brakes to be operated in the train makes such severe demands upon the equipment that our development department is busy keeping up with the requirements so that our air brake equipment may meet the conditions, especially in the service application of brakes.

You will readily appreciate, from what I have said, that the conditions which made the new improvements necessary, were mainly the fact that the air brake requirements are more than four times as severe, as far as the serial action is concerned, when we are obliged to operate 100 per cent of the brakes in the train, as against former rulings that 50 per cent of the cars should be equipped and 50 per cent operated. In other words—it is not long since that a 100-car train might have but 25 brakes on the head end actually operated; whereas, today the tendency is toward having 100 brakes in actual operation on 100-car trains.

I have not said much to you about the improved air brakes for passenger trains, which were also demonstrated this summer, but, as the time is growing late, I think it will be impossible to cover the passenger brake situation this evening.

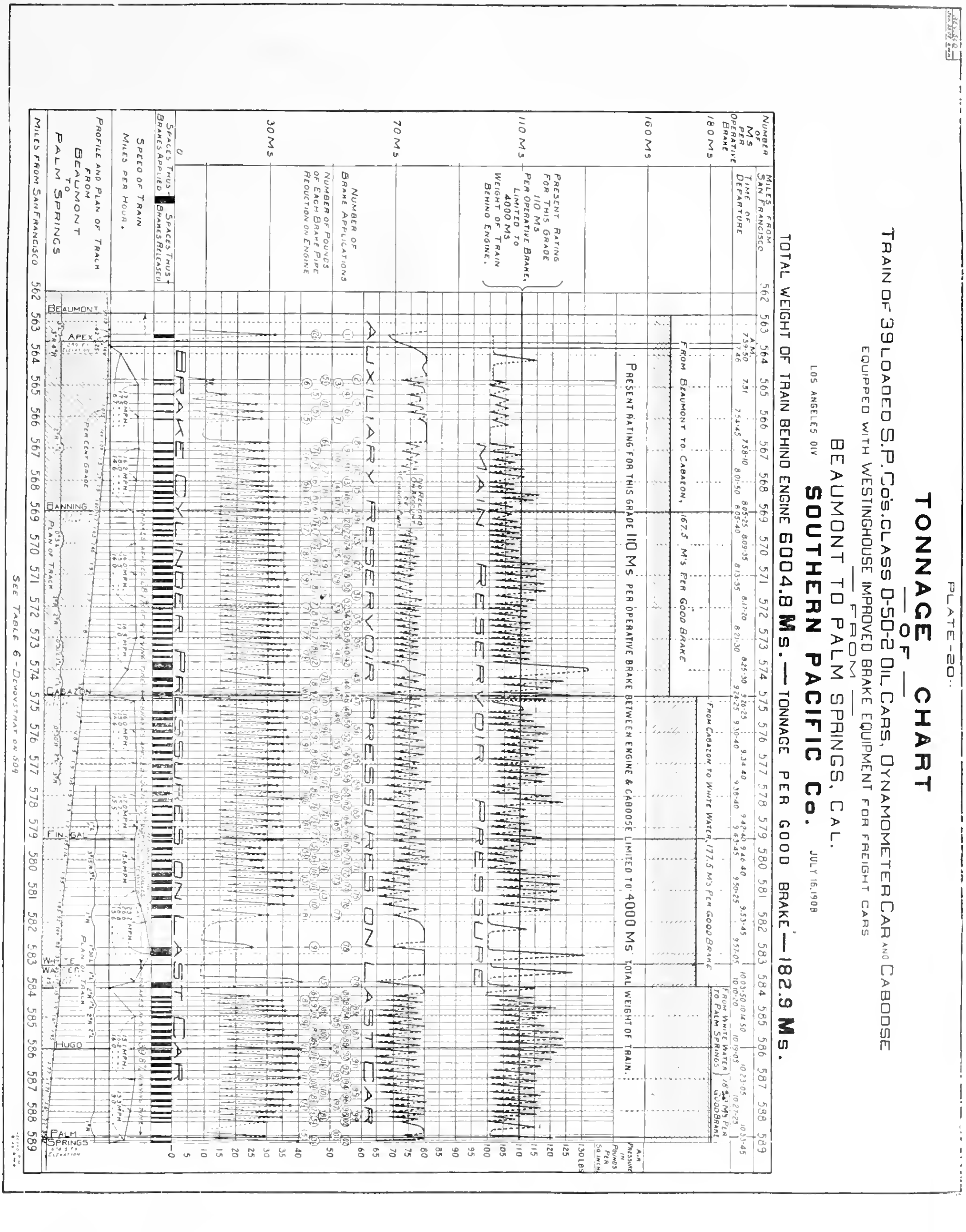


PLATE-20.
TONNAGE CHART
OF
TRAIN OF 39 LOADED S.P. Co's. CLASS D-50-2 OIL CARS, DYNAMOMETER CAR AND CABOOSE
EQUIPPED WITH WESTINGHOUSE IMPROVED BRAKE EQUIPMENT FOR FREIGHT CARS
FROM
BEAUMONT TO PALM SPRINGS, CAL.
LOS ANGELES DIV
SOUTHERN PACIFIC Co.
JULY 16, 1908
TOTAL WEIGHT OF TRAIN BEHIND ENGINE 6004.8 Ms. — TONNAGE PER GOOD BRAKE — 182.9 Ms.
NUMBER OF MS PER OPERATIVE BRAKE
MILES FROM SAN FRANCISCO
TIME OF DEPARTURE
FROM BEAUMONT TO CABAZON, 167.5 Ms PER GOOD BRAKE
FROM CABAZON TO WHITE WATER, 177.5 Ms PER GOOD BRAKE
PRESENT RATING FOR THIS GRADE 110 Ms PER OPERATIVE BRAKE BETWEEN ENGINE & CABOOSE LIMITED TO 4000 Ms TOTAL WEIGHT OF TRAIN.
PRESENT RATING FOR THIS GRADE 110 Ms PER OPERATIVE BRAKE, LIMITED TO 4000 Ms WEIGHT OF TRAIN BEHIND ENGINE.
MAIN RESERVOIR PRESSURE
AUXILIARY RESERVOIR PRESSURES ON LAST CAR
BRAKE CYLINDER PRESSURES ON LAST CAR
NUMBER OF BRAKE APPLICATIONS
NUMBER OF POUNDS OF EACH BRAKE PIPE REDUCTION ON ENGINE
SPACES THUS BRAKES APPLIED
SPACES THUS BRAKES RELEASED
SPEED OF TRAIN MILES PER HOUR.
PROFILE AND PLAN OF TRACK FROM BEAUMONT TO PALM SPRINGS
MILES FROM SAN FRANCISCO
BEAUMONT
APEX
BANNING
CABAZON
FINGAL
WHITE WATER
HUGO
PALM SPRINGS
AIR PRESSURE IN POUNDS PER SQ. INCH
130 LBS
180 Ms
160 Ms
110 Ms
70 Ms
30 Ms
562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589

We might take a look at Plate 32, however, which represents a pair of stops made with the improved and with old style air brake equipment on an 8-car train in the demonstrations on the Hayward branch of the Southern Pacific. The trains were accelerated to about 70 miles per hour and the stops shown on the chart were made from as nearly similar speeds as possible. The train was so equipped with both types of apparatus that a run could be made with one style of equipment and immediately followed by the other, as the change could be made by simply re-arranging the cut-out cocks. It will be noted that with the same pressure and from approximately the same speeds, the stop was made in 1,673 feet with the improved equipment, as against 2,037 feet with the present type of high speed air brake apparatus.

The primary object of the improvement in air brakes for passenger trains is, of course, to improve the factor of safety, but, if I had time, I could explain to you other considerations in the matter of flexibility which it is now possible to add to the air brake equipment for passenger trains, because the five limiting conditions which I mentioned earlier in the evening, are not so rigid as applied to air brakes for passenger trains, as there is not so much foreign car interchange. The Pullman cars being equipped with the improved brakes and constituting most of the foreign cars in the trains, makes it possible to depart somewhat from former standards.

The saving in distance of the stop by the improved equipment, as shown on the diagram on Plate 32, illustrates that the train with the old style equipment would be going approximately 32 miles per hour, while the train with the new equipment would be at rest, meaning that there would be about 35,000,000 feet pounds of energy remaining in the train still moving, as against the train being at rest with no collision energy, with the improved equipment.

I wish to say in closing that, in all the years we have been in the air brake business, and, of course, been making demonstrations in different parts of the country, we have never had the equipment to use, or the conditions so perfect or the general air brake requirements so exacting as we have had in California this summer. The equipment furnished us by the Southern Pacific being practically perfect for our requirements, and the use of oil burning locomotives in our demonstration, made it possible to carry out a program in a way that was new to us. Heretofore, when we have attempted to accelerate freight and passenger trains to certain speeds in miles per hour, it has been very difficult to secure uniformity on account of difficulty in getting coal burning engines to stand the strain of maximum speeds, but with engine No. 2765, for instance, which is one of the heaviest Southern Pacific freight locomotives, we never lacked for steam during our demonstration, as, with oil for fuel, it was possible for the fireman to keep the steam at the pre-determined pressure from the beginning to the end of the demonstration. Also in our passenger runs, we could get the maximum out of the locomotive every time.

Our committee also had never experienced such uniform climatic conditions as during our stay in Southern California. The temperature, humidity and general conditions affecting the track were almost absolutely uniform from day to day throughout the entire period. The rolling stock of all kinds used in our demonstration could not be improved upon, and we, of course, have the Southern Pacific officials to thank, not only for the satisfactory equipment given us to work with, but for the hearty co-operation they favored us with throughout the entire summer, placing every facility in our hands, not only for making the demonstrations, but in working up the data secured, as illustrated by the charts, some of which I have explained to you here in my talk this evening. I thank you very much.

Mr. Babcock: Gentlemen, I think we can all say that we have been very fortunate in having this kind of a talk; and, inasmuch as the hour is late, I think we had better confine our discussion to such questions as some members might ask. Is there anybody that can suggest some questions? There does not appear to be anybody with any questions. Mr. Newell, would you like to contribute to the evening's entertainment?

Mr. Newell: I think the subject has been so well and entirely covered by Mr. Bartholomew that it is not necessary for me to add anything.

Mr. Babcock: Mr. Newell was with Mr. Bartholomew in charge of the scientific part of the demonstrations.

There is one point that came to me. I have had great trouble in getting manufacturers to depart from the manufacturers' standard, and it gives me great pleasure to see a manufacturer run up against the standards in the hands of the customer.

Mr. Bartholomew: It is the purchasers' standards that limit us.

Mr. Babcock: My experience has been confined to the standards of manufacturers. The subject of air brakes became very interesting to me once—in this way: I was on a foreign road going down grade, and it was dark and raining. I noticed that the train was actually gaining speed and the gauges showed very clearly what was going on. I found that the engineer was gradually losing his air, and the train was absolutely getting beyond control. The point as to where the equalization was going to take place became very interesting. I sent for the train conductor and asked him what he thought of the indications as shown by the different brake gauges. He smiled very broadly and said that was the way they always ran down that hill, but they were pretty near the bottom then.

Mr. Bartholomew: I want to say that the time of re-charge at the rate of a pound a second is the thing that has limited, I might say, the factor of safety of the brake on passenger trains.

In the passenger equipment, I could not fully cover that part of the demonstration on account of the lateness of the hour—one of the important features of the improved equipment is that the pressure is restored in the auxiliaries at the rate at which it escapes out of the brake cylinder; so that if the brakes had been fully released, the pressure would have been fully restored. In the case Mr. Babcock speaks of, the engineer had made brake applications faster than

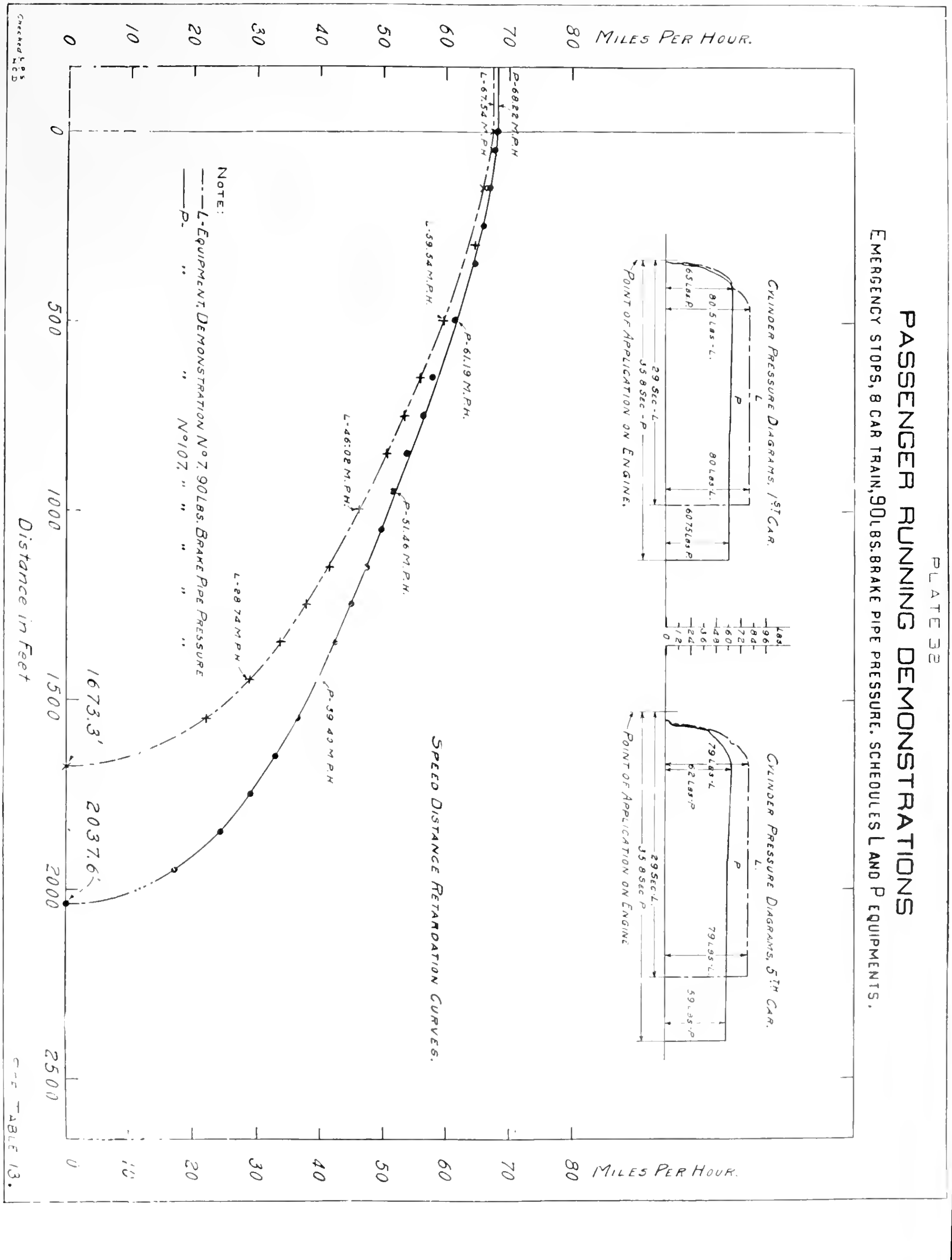


PLATE 32
PASSENGER RUNNING DEMONSTRATIONS
EMERGENCY STOPS, 8 CAR TRAIN, 90 LBS. BRAKE PIPE PRESSURE. SCHEDULES L AND P EQUIPMENTS.
Cylinder Pressure Diagrams, 1st Car.
Cylinder Pressure Diagrams, 5th Car.
Point of Application on Engine.
29 Sec.-L.
35.8 Sec.-P.
Speed Distance Retardation Curves.
Miles Per Hour.
Distance in Feet
P-68.22 M.P.H.
L-67.54 M.P.H.
L-59.54 M.P.H.
P-61.19 M.P.H.
L-46.02 M.P.H.
P-51.46 M.P.H.
L-28.74 M.P.H.
P-39.40 M.P.H.
1673.3'
2037.6'
Note:
L-Equipment, Demonstration No. 7, 90 Lbs. Brake Pipe Pressure
P. " No. 107, " " "
See Table 13.

re-charge could take place with the old style equipment. The re-charge improvement in passenger brakes is probably the most important development in the passenger triple valve, which, as I explained to you, is a departure from the standard and has features injected into it by the necessity of our passenger service which are not in the freight trains, but particularly to serve where we have to make application more rapidly than under the old conditions, and to secure shorter stops in emergency.

Mr. Babcock: I think we owe Mr. Bartholomew very sincere thanks for appearing here tonight. In the absence of any desire to question him, perhaps the meeting had better adjourn.

Mr. Hunt: Before the meeting adjourns I want to express the thanks of the executive committee for the attendance which has been given by the various members.

FOREST PRESERVATION IN CALIFORNIA.

California took another step in its effort to promote the practice of forestry within the State when Governor Gillett signed the bill providing for the creation of county boards of forestry. This bill authorizes the county supervisors to appoint a Board of Forestry, whose secretary shall be a trained forester. Such forester shall have power to enforce the provisions of the Act, and all lawful orders of the Forestry Board, and in addition is vested with the powers of a peace officer to make arrests for violation of the law.

The County Board of Forestry is granted exclusive power to decide upon the variety, character and kind of trees, hedges and shrubs that shall be planted upon county roads, highways, grounds and property, and to determine all questions respecting the pruning, cutting and removal of all trees, hedges and shrubs, and the extent and manner in which such work shall be done.

A violation of any of the provisions of the Act shall be deemed a misdemeanor. A special fund was also created to be made up of any penalties incurred through a violation of the provisions of the Act, and all moneys thus received shall be available to cover the expenses of the Board.

This law was the direct result of the work accomplished by Riverside County, which has for some time maintained a paid forester to look after the setting out and caring for trees within the county. The results obtained in that county were so satisfactory that it was thought desirable to extend the scope of the work to other localities.

NEW BURGLAR ALARM.

Deputy Consul General Ulysses J. Bywater reports that a Dresden engineer has invented a simple appliance for giving warning of attempted burglary or forcible entry into premises, which is thus described by the consular officer:

This appliance has been thoroughly tested by the police authorities of Dresden and Berlin, and the most experienced criminal experts were unable to find flaws in the apparatus, or to enter into the protected premises without starting the alarm. The appliance itself is very simple, consisting of a curtain or portiere, wired with fine conductors. At certain places on the curtain are affixed small metal knobs, which are connected with the wire conductors. The curtain is then drawn across the window or door, or around the safe, and the slightest disturbance of this position immediately breaks the circuit, as the metal knobs are thrown out of contact with each other.

Should the burglar notice the wires and cut one or several thereof, the breaking of the circuit would also start the alarm. Any other attempt to destroy the protecting curtain would also be noticed. Any curtain, unless made of fireproof material, would also act as a fire alarm. The alarm itself may consist of a series of bells, lights, or other electrical appliances. This invention can be used to protect doors, windows, safes, etc., and naturally the curtains, forming the most conspicuous part of the device, can be designed and arranged to suit individual taste. The inventor recently gave the writer an exhibition of the working of the apparatus, and the impression was that this invention is unique in simplicity and reliance.

PLANS TO INTRODUCE WIRELESS IN CHINA.

Consul Wilbur T. Gracey sends from Tsingtau, the following note in regard to the plan for using wireless telegraphy in China:

The acting president of the board of communications has sent an order to the telegraph administration in Shanghai directing it to obtain from foreign firms tenders for wireless telegraphic installations which the government desires to establish between the Altai Mountains and Ahsien in the northwest of Chinese Turkestan. The question of a wireless telegraph installation in the interior was pointed out by the administration as one of the most important needs of China today. It is said the board considers it practically impossible to establish the ordinary land lines across the great deserts between Peking and the extreme northwest, but the natural difficulties could be surmounted by the use of wireless. Balkson's system is considered by the board to be the newest and most efficient, and the administration was instructed to make the necessary inquiries, and were also given a list of questions as to the technical matters which it was their business to answer.

IMPORTANT TRANSFER OF WATER POWER.

The largest deal in water rights ever made in Shasta County was consummated in Redding, Cal., recently, and the deeds of transfer were placed on record.

A sum between $75,000 and $100,000 was involved in the transaction by which the Sacramento Valley Power Company acquired real estate and water rights on North Battle Creek from J. M. Cunningham, R. P. Cunningham, J. Johnson, J. W. Dailey, Joel Cunningham and J. D. and J. W. Ogburn. These are pioneer farmers of the Shingletown region, and the water rights disposed of are among the oldest in the county.

The water acquired by the Sacramento Valley Power Company constituted only a portion of the water of North Battle Creek that is to be used in developing electrical power in the southeastern part of the county.

North Battle Creek is the stream on which the Northern California Power Company's power plants, Kilare excepted, are located. The water rights acquired by the Sacramento Valley Power Company are the oldest and best on North Battle Creek and the water has hitherto been used exclusively for irrigating purposes.

The Sacramento Valley Power Company is a consolidation of the Northern Light and Power Company and the Shasta Power Company. The first owned a power plant on South Cow Creek, 20 miles east of Redding. The second owned a plant on Snow Creek, 28 miles east of Redding.

The consolidated company's plants have a generating capacity of 3600 horsepower.

CURRENT COMMENT

Concrete railway ties have been found a success in Italy. The first lot of 300,000 proved so satisfactory that another similar lot has been ordered. They are offered for sale at $1.48 each.

Concrete covered with sea water for one hundred years was recently removed in the harbor at Brest, France. Iron bars embedded in the concrete did not show the least indication of rust, showing that concrete is a perfect preservative of iron, even when placed under sea water.

Asbestos is finding a new field as a result of improved construction of electric railways. The need of an insulating material less brittle than glass and porcelain and more durable than rubber, has led to the adoption of new compositions which, with asbestos as the base, possess both tensile strength anr heat resisting properties.

A new type taxi-cab, steam-driven with oil fuel, will shortly be seen running in London. Outwardly the vehicle resembles the standard type of motor-cab, but in place of the motor there is a three-cylinder vertical steam engine fitted, the generator and condenser being under the bonnet. A single lever on the steering wheel controls both speed and generation.

The relations of the Forest Service to miners has been productive of much friction. Following numerous protests made by the miners, the American Mining Congress appointed a committee to confer with Gifford Pinchot, Chief Forester. Two conferences were held, on March 15th and March 18th, of this year. The outcome of the action of the latter is set forth in a letter just received by the Mining Congress from Mr. Pinchot. Mr. Pinchot states that efforts will be made to develop a plan whereby the restrictions of the Forest Service will cause no injustice to any mining man.

A singular line of investigation is being pursued by Dr. F. Peterson, Professor of Psychiatry at Columbia University, and Dr. Jung of Zurich. It appears that if a weak electric current is passed through a person's body from hand to hand, with a reflecting galvanometer in the circuit, any emotion experienced by the subject is at once indicated by a change in the conductivity of the tissues, and a corresponding displacement of the spot of light. This phenomenon, it is said, can be utilized in the detection of crime, to test the validity of evidence, or to identify from a number of suspected persons the guilty one.

The total cost cf buildings erected in the principal cities of the United States in 1908 was $546,467,390, according to Jefferson Middleton, of the United State Geological Survey. New York ranked first, the cost of its buildings exceeding those of its closest competitor, Chicago, by $50,584,582, or more than 75 per cent. If the cost of operations in Brooklyn, the third city in rank, is added to that of New York, the total will be $163,684,622, or 30 per cent of the cost of the building operations in 49 cities. San Francisco is fourth in rank, Philadelphia is fifth, and St. Louis is sixth. Seventh in rank is Seattle, which spent more for buildings in 1908 than Pittsburg, which was eighth, or Boston, which was ninth.

London's latest electric railway—the suburban line of the London, Brighton & South Coast Railway, between Victoria Station and London Bridge, by way of East Brixton, has just been opened. It represents electrification of a steam railway and competition with electric street railways and motor omnibuses. It also represents 23 miles of single track. The cars are of the corridor type with separate compartments, unlike the type of long open coaches so generally familiar on electric railways. The engineering work of the line has been difficult by reason of the maze of crossings at the two termini and the low bridges on the route under which the trolley has to pass.

An eleven-million-dollar building is under construction for a retail dry goods company in New York City. The building will be completed and the store opened before autumn of next year. It will have more than 1,000,000 feet of floor space and will cost about $11,000,000, including the site. It is announced that 24,000,000 pounds of structural steel will be used, 120,000 cubic yards of earth and rock excavated, and the two acres of glass will be used for the windows. Twenty-four hundred steel columns will support the weight, and there will be 914 feet of show windows. Fifty electric elevators will be housed in a mile and a half of shafts, and the boilers will develop 4000 horsepower. The electrical work will require 240,000 feet of wire.

A new musical instrument operated by electricity has lately made its first public appetrance in Boston at a concert, in which the Boston Symphony Orchestra also took part. The new device is called the Choralcelo, and its essential peculiarity consists of the vibration of piano wires by electromagnets, resulting in the production of tones of surpassing purity, if the judgment of those who have heard the instrument is to be credited. The working parts of the instrument are housed in a case resembling that of a rather large upright piano, and the instrument may be played as a piano by the ordinary percussion hammers and keys, either separately or at the same time, with the electromagnetic action. The tones of the instrument are said to resemble those of both stringed and wood equipment for orchestrial service, and the organ characteristics are reported to be perhaps the most beautiful of all. Less than one horsepower of electrical energy is required to operate the Choralcelo in full harmony.

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CONTENTS

High Voltage Transmission

There are but few transmission engineers in the Pacific Northwest who are not now interested in the problem of raising their line voltage. Some have already accomplished it, others are now in the throes of changing, and the rest are planning to do so. Eleven thousand volt lines are being raised to thirty-three, and twenty-five to sixty, the latter being so frequent as to be almost standard for long-distance transmission. The reason for this increase in line voltage is three-fold.

First and most pressing is the greater demand for power which has invariably resulted since the lines were built. This demand has often surpassed the most sanguine hopes of the projectors and exceeds even the reserve space planned for future expansion of generating capacity. Then again there is the recent improvement in high voltage equipment, especially high tension insulators and protective apparatus, whereas when many of these lines were installed it was not considered safe to use a voltage above twenty-five thousand. Lastly, and most potent, is the factor of cost, which increases with the voltage used. For an initial installation, through rough country, and intended to supply a consumption yet to be created, the lower voltage is cheaper. As the market is developed and the demand increases, it is found more economical to use the same line conductors and the same poles by raising the voltage, than it would be to construct a new line.

New generators are installed in plant vacancies to use surplus power at a tithe of the original unit cost. In many cases the transformers were originally wound so as to be connected for half voltage until the load became great enough to require full voltage. In other cases the transformation is effected by changing from delta to star connection.

This raise in voltage is contrary to the usual Eastern practice which holds continuity of service to be of paramount importance. But as all the great hydro-electric systems in the Northwest are equipped with steam auxiliary for peak and emergency load the reliability factor is counter-balanced by the more serious item of cost. It is a far different undertaking to construct a line with limited capital to an undeveloped market than it is through a well-settled country offering a safe return upon the investment. In a pioneer railroad installation double track and Pullman cars are not the first matters to be considered. The question of dollars outweighs the features of theoretical engineering perfection.

The problem of minimizing cost is further complicated by the ever-threatening competition from duplicating systems. While these occasionally redound temporarily to the benefit of the consumer, too often they are conceived by unscrupulous promoters who raise false hopes in a confiding investor. Experience has shown that in a community where the power consumption is necessarily limited the only possible result of such duplication is the absorption of the weaker and a consequent increase in rate to pay the interest on the double investment. Ultimately these fiascos intimidate the investor and hinder worthy projects which must thus suffer from the misdeeds and demerits of others.

A TRIBUTE TO THE MEMORY OF GEORGE P. LOW.

In the death of George P. Low the electrical fraternity has los one of its most able writers and a man of many sterling qualities.

To no one man is due more credit for the exploitation of the western development in electrical lines than to the late Mr. Low. Dating back to the first electrical publication of the West, The Pacific Lumberman, Contractor and Electrician, George P. Low was the associate editor and his early writings will stand as a valuable contribution to history of hydro-electrical science. He it was who gave to the world the first detailed description of the high tension transmission problems that were at that time being solved.

His friends were many and his acquaintance legion and not one of whom today but feels the personal loss.

For many years Mr. Low occupied the position of electrical engineer for the Underwriters' Fire Association. He was prominently connected with the Pacific Coast Gas Association as its historian, and was at the time of his death president of the Pacific Coast Transmission Association, and had been connected for some time with A. M. Hunt of San Francisco.

George P. Low.

Sidney Sprout, a well known electrical engineer of San Francisco was associated with Mr. Low during the past years and has written the following little tribute to his memory:

"In the demise of George P. Low I feel that one of our number has passed to the beyond who will be missed more than any among us and that the western country has lost a man who will more than any other call up thoughts of the past.

It was in the year of the Mid-winter Fair, 1894, that I first met Mr. Low, and being an eastern engineer coming to this western country amongst strangers, the hearty welcome he extended me will never be forgotten and when I afterward learned the effort it would have been for another person I appreciated the fact that I had met one of the greatest characters in my profession—one of the most generous, charitable, brilliant and most popular friends I ever had the good fortune to meet. This feeling was verified later through my connection with him during the early history of the Board of Fire Underwriters, the "Pacific Lumberman," the "Journal of Electricity, Power and Gas," the Transmission Association and the engineering of the old Pacific Power Company and San Rafatel Gas and Electric Company and the several large fire losses of lighting and power stations where we sat together on appraising boards.

I say generous, as none ever came to him in need that he was not extended the best that could be given, and many times have I seen him leave his work to assist some one looking for work, encouragement, information or sympathy.

He was a brilliant writer and those who have read his interesting articles in the "Journal of Electricity, Power and Gas," and the eastern electrical publications know full well the debt of gratitude the Pacific Coast owes him for placing on record and incorporating in history the early work of the western engineers in the pioneer days of electrical development.

It is a matter of record among his many friends that we were unable to show our appreciation of his good work during his life time and that in his efforts to make the light of others shine his own was apparently hidden beneath the bushel, although it is certain that his light will shine long after he is gone."

PERSONALS.

Robert J. Thompson, manager of the Welsbach Company at San Francisco, left this week for an Eastern trip.

Phil Levy of the Levy Electric Company, San Francisco, left on May 22d for a trip East which he expects will cover two months or more.

C. C. Hillis, manager of the San Francisco house of the Electric Appliance Company, left for a trip to Chicago and the East on June 2d.

G. I. Kinney, manager of the San Francisco office of the Fort Wayne Electric Works, left on June 4th for an outing of a week or two in the country in search of a much needed rest.

H. P. B. O'Dogherty, formerly manager of the San Jose & Santa Clara Railroad Company, has been appointed manager of the Central California Traction Company, which operates the electric line between Lodi and Stockton, Cal.

B. N. Atkins of Eugene, Ore., has been elected manager of the electrical department of the Walla Walla Valley Traction Company, and George D. O'Conner of Walla Walla has been made manager of the railway department of the company.

C. H. Johnson of the San Francisco office of the Western Electric Company has returned from a trip to Los Angeles. While there he took a little outing to Catalina Island with J. C. Kirkpatrick, president of the National Pole Company of Escanaba, Mich., and reports a catch of 34 fish aggregating 1,000 pounds during the two days of their visit.

Dow S. Smith, formerly general superintendent of the Brooklyn (N. Y.) Rapid Transit Company, has been elected vice-president of the Panhandle Electric Railway & Power Company, Spokane, Wash., which he and his associates have organized to develop a hydro-electric plant on the Priest River in Idaho and build a thirty-mile standard gauge electric railway from Priest River to Coolin, Idaho.

T. E. Bibbins, Assistant General Manager of the General Electric Company of the Pacific Coast returned on May 31st from a four weeks' trip through the East. He verifies the report received in San Francisco to the effect that he was the winner of the cup in the golf tournament of sales managers of the General Electric Company, held during the conference of that company at Pittsfield, Mass.

The many friends of John H. Dale, President of the Dale Company, New York, will regret to hear that he is now confined to his home as the result of a severe attack of pneumonia. The extent of Mr. Dale's interest and association with the electrical business will be appreciated when it is known that the convention of the National Electric Light Association which has been held during the past week at Atlantic City will be the first he has failed to attend in nineteen years.

ANNUAL PICNIC OF THE ELECTRICAL CONTRACTORS.

Chester A. Sayles, the Umpire.

On May 29th all of the San Francisco Electrical Contractors with their numerous friends and families journeyed to Fairfax Park, a beautiful spot across the bay from San Francisco, where the entire day and part of the night was spent in an old-fashioned picnic with dancing, baseball matches and various contests of skill participated in by man and woman and child.

The morning was given up to general visiting and renewing of old friendships and the making of new. The real fun began in the afternoon when the music arrived and the dancing was started in the outdoor pavilion.

During the morning a baseball game between the Oakland and San Francisco contractors attracted a great deal of attention and was won by the Oakland contingent by a score of 13 to 8. In the afternoon a picked nine from both teams of the contractors played a picked nine of electrical jobbers with disastrous results to the latter, the score being 28 to 7 in favor of the contractors. The jobbers' team was made up entirely of captains and every captain was a star of the first magnitude. Their class of play was, however, of too high a grade for the contractors to understand and the contractors went right along and played old fashioned ball and won.

Chester A. Sayles of the John R. Cole Company umpired to the entire satisfaction of every one but the losers.

Cox, Second Base for Contractors, at Bat and Captain Loughborough, Jobber, Catching.

The entire affair was a most enjoyable one and everyone had a good time. The outing was in charge of the following joint committee and its members are entitled to great credit for the success with which the program was carried out: A. S. Hanbridge, C. E. Wiggin, P. Decker, L. R. Boynton, W. W. Hainscom.

PICNIC NOTES.

"Jack" Heyer of the San Francisco City Electrical Department was one of the guests.

Following the picnic a small and select party had a very merry supper at Sanguinetti's.

Cox, Pitcher for the Contractors.

"Bob" Martland and Peter Murman, former contractors, were present, just as if nothing had ever happened.

There was no hammer-throwing contest and rumors that such a contest was won by John R. Cole are, therefore, untrue.

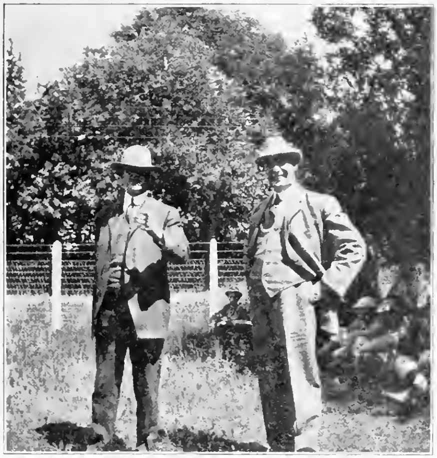
Jenkins, Contractor, Catching. Captain Hickox, Jobbers, at Bat.

The Oakland ball players were fortunate in having a fair rooter on the grounds who certainly did a great deal to win the game for them. She had a first-class "rooting voice" and her "Go it, you Gene!" could be heard for miles.

F. H. Poss looked natty and attractive in a blue suit with stripes running up and down and a straw sailor hat. He was

entered for the middle-weight woman's race, but the committee barred him at the last minute.

For a few minutes it looked as if there would be no ball game. Captain Goodwin of the jobbers made a protest against the contractors playing with spiked shoes, but after talking it over with Captain Woodward—also of the jobbers—it was decided to waive the point.



John G. Sutton and Geo. A. Cole Discussing the Proper Channels for the Distribution of Electrical Supplies.

During an intermission in the dancing, R. D. Holabird was called upon for a song and gracefully responded by singing "Dearie." Mr. Holabird is the possessor of a romantic tenor voice of great range, particularly adapted to picnics. He was accompanied on the piano by Herr Frosch.

Finish of Women's Race.

During the afternoon some very exciting running races took place with the following results:

Men's Heavyweight—Carlson first, Butte and Collins tie, second.

Women's Middleweight—Mrs. T. W. West first, Mrs. Booth second.

Men's Lightweight, J. H. Scott first, W. Burns second.

Women's Lightweight—Miss Clair Steinbring first, Miss Ida Finklestein second.

Boys—Ross West.

Girls—Emma Reimann first, Madeline Steinbring and Marion Wiggins tie, second.

Baby Boys—Robert Martland Jr. first, Edwin G. Davis second.

Every one in attendance received a numbered ticket on entering the gate and during the afternoon the duplicates were drawn from a hat in the Dancing Pavilion. There were eleven gate prizes and the winning numbers were as follows:

15, 137, 119, 448, 177, 163, 469, 500, 97, 13, 405.

The holders of these numbers are requested to notify W. W. Hanscom, Grant Building, San Francisco, to that effect.

TRADE NOTES.

The San Francisco office of the Paraffine Paint Company has been moved from the Merchants' Exchange Building to 34 First Street.

The additions to the Hawthorne, Ill., plant of the Western Electric Company are being pushed ahead and will be complete this summer. These additions and improvements allow for a considerable expansion for the telephone end of the company's business.

The Dean Electric Company of Elyria, Ohio, report the sale to the West Shore Telephone Company, Lemoyne, Pa., of a 500-line common battery multiple exchange complete. The order includes power and terminal apparatus and will be installed immediately.

At the West Allis Works of the Allis-Chalmers Company there is great activity in the gas engine building line, as a result of recent orders crowding close upon others received since the first of the year, the units for which are now being assembled for shipment.

The Western Electric Works of Portland, Ore., is carrying on its business in part of the new brick building which is rapidly taking the place of the ancient frame structure at Sixth and Ankeny, and will move into their former location as soon as the building is completed.

In our issue of May 29th we included an item in reference to sales of the Allis-Chalmers Company during March and April of this year in which we cited the aggregate of apparatus as 61,985 h. p. We desire to correct these figures and to call attention to the fact that the aggregate of sales reached the enormous capacity of 161,985 h. p.

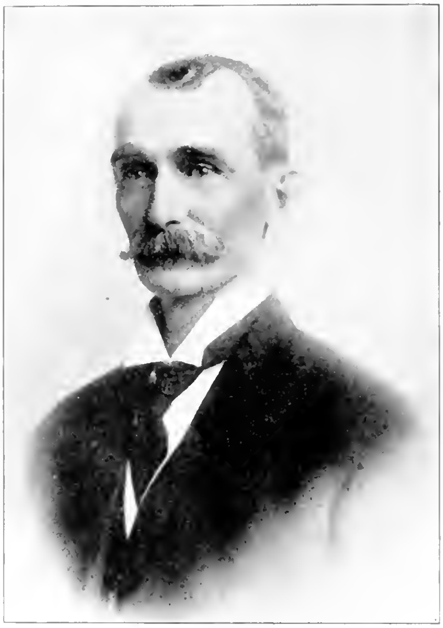
L. E. Baker, formerly with the American Steel & Wire Company, and J. E. Shedden formerly with the Bradley Engineering Company, have formed a partnership and will act as engineers' agents for handling mining, sawmill and irrigating machinery at Spokane, Wash. The firm is also acting as consulting engineers and designers of complete plants. Later a machinery business will be established and a stock carried. The company has opened up offices at 615 Jamieson Building.

The Bliss Electric Company, Inc., operating the Tungsten Guarantee Company, has been organized for the transaction of business at 215 University Street, Seattle, Wash., capitalized at $25,000, with the object of conducting a general electric supply, fixture and specialty business. Their place of business is located in the center of the retail district of Seattle and it is their intention to cover the entire Northwest territory. The organization of this company was promoted by F. U. Bliss who for the past two and a half years has been associated with the Seattle-Tacoma Power Company at Seattle as Purchasing Agent and previous to his connection with that company was with the Idaho Consolidated Power Company of Pocatello, Idaho.

MAYOR WILL OPEN MACHINERY EXHIBIT.

National Association, Stationary Engineers, to Conduct Show at Convention.

Mayor Taylor is to press the button which will set in operation the machinery in the exhibition to be held in the Auditorium the week of June 14th in connection with the sixth annual State convention of the National Association of Stationary Engineers. Dr. Rader will deliver the invocation at 2 o'clock the afternoon of the opening day, and then Mayor Taylor will start the machinery.



Fred J. Fischer, National President.

The machinery manufacturers and merchants are manifesting much interest in the coming exhibition and are eagerly seeking space in the Auditorium for their exhibits. Of the 15,000 square feet available, more than 11,000 has been sold and paid for, while the demands that are still being made indicate that the entire floor space will be filled before the opening of the exhibition.

Flags, bunting and streamers will be used to decorate the interior of the building, and hundreds of incandescent lights will add to the brilliancy of the scene at night. A band of twenty musicians will play afternoon and evening throughout the week.

The convention to be held in connection with the exhibit will last three days. H. D. Saville, the State president, has arranged for the presence of Fred J. Fischer, the national president, at the convention. There will be a number of lectures by prominent engineers and professors each evening. These will be free to the public.

The meeting of San Francisco No. 1, N. A. S. E., held Thursday, May 27th, was occupied disposing of business incidental to removal to a new hall at 131 Fulton street and details of the smoker and reunion to be held there on June 10th.

The convention committee reports matters concerning the big convention and mechanics' fair to be opened at the Auditorium June 14th to be progressing finely. The near approach of the opening date brings a vast number of details for attention, but the energy and care displayed by the committee of arrangements is sufficient assurance that everything will be in order for a prompt and successful opening of the exhibition.

Under educational topics, Bro. Maher gave an interesting explanation of alternating current apparatus, particularly as regards "frequency" and its bearing on the application of alternating currents of different frequency to power systems.

H. D. Saville, State President.

Bro. Bonney talked on the question of determining the horsepower of gas engines, and the power required to drive air and ammonia compressors.

A. T. PEERY, Secretary.

THE CALIFORNIA STATE ASSOCIATION, N. A. S. E.

The California State Association was formed in response to a desire of the Engineers of the State to meet together, exchange ideas and promote their general welfare on a broader basis than they had before enjoyed.

The great underlying purpose of the N. A. S. E. is the education of its members in the science of steam engineering and its allied industries, and the inculcation of those things which tend to elevate the individual as men and citizens.

The first convention was held in this city in 1904, and since that time San Francisco has been destroyed and rebuilt and the better to show to delegates and visitors the marvelous progress that has been made in the rebuilding of the city a mechanical exhibit similar to the old Mechanics' Fair has been arranged in the Auditorium at Page and Fillmore streets, which will be open to the public during convention week, June 14th to 19th, inclusive.

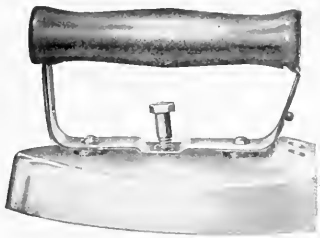
The local committee and members have worked tirelessly for the success of this event and their motto is, BOOST the N. A. S. E., BOOST for SAN FRANCISCO.

INDUSTRIAL

A NEW FLAT IRON.

The General Elec'ric Company has lately brought out a new flat iron, the heating unit of which is new both in material, construetion and shape.

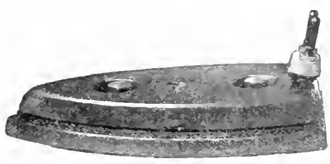
The resistance metal used is named by its patentees, "Calorite," and is capable of withstanding oxidation to a point several hundred degrees hotter than any metal previously used in heating devices, its melting point being 2370 degrees F. The resistance of "Calorite" is twice that of nickel-silver and seventy-three times that of copper and it is this high specific resistance which enables it to be used in a single thin grid-layer or leaf. In the majority of designs, the heat must either pass through two or more



G. E. Flatiron—Top of Iron.

layers of heat insulation or radiate through an insulating air space. The "Calorite" leaf unit has such close thermal relation to the working surface of the iron that it cannot overheat. This construction obviously precludes the use of any auxiliary protec ive device to insure the life of the heating unit.

In the new iron the heat is evenly distributed over the entire working surface. A scorch proof shows that this is practically as well as theoretically true. The toe, the heel and both sides are heated equally providing for efficient ironing in any direction.



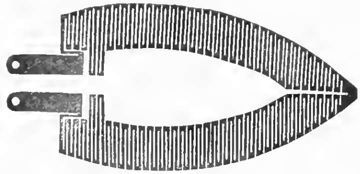
G. E. Flatiron—Base of Iron.

The construction of the iron is very simple and rugged. The body is of two hard gray cast iron plates held together by two heavy steel bolts. The thin leaf unit is firmly clamped between these plates and separa'ed from them only by a sheet of clear amber mica two thousandths of an inch thick which provides the necessary insulation.

The shell cover, held by one bolt, carries a well made handle riveted to it, a continuous air jacket being formed between this shell cover and the working part of the iron. This insulating air jacket not only covers the top of the iron but the sides and ends as well, and the use of the objectional asbestos is eliminated.

The attachments are of the most approved design and are made of unbreakable material, the use of porcelain being entirely avoided. The leaf unit flat iron will be equipped with plain attaching plug, with combination indicating switch plug or with permanently attached cord, if desired.

The few parts of the new General Electric iron are readily interchanegable and the iron can be completely disassembled by removing three bolts.

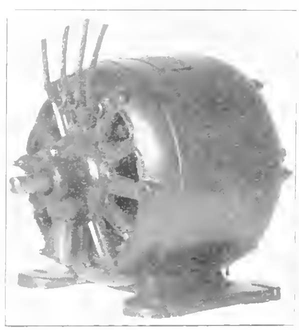


G. E. Flatiron—Calorite Heating Unit.

The new heat unit iron is available in the five-pound, or 450 watt size, and the six-pound, or 550 watt size. The iron is finished in highly polished nickel.

WESTINGHOUSE TYPE DA ALTERNATING CURRENT MOTORS.

The advent of thoroughly prac ical and satisfactory small electric mo'ors is revolutionizing the me'hods connected with modern living. Shrewd inventors were first to see the possibilities for these wonderful little labor savers and have already applied them to machines for performing many tasks formerly done laboriously by hand. Almost any process hat must be performed repea'edly with little or no variation can be done successfully and much more economically by a motor driven mechanical device than by any other means. Electric motors in small sizes are rapidly passing from the class of luxuries into the class of necessities, and it is safe to say that within a few years small mo'or driven machines will be doing the larger part of the routine work in homes, hotels, restaurants, offices, stores, shops, factories, etc.



Westinghouse Type D.A. Motor.

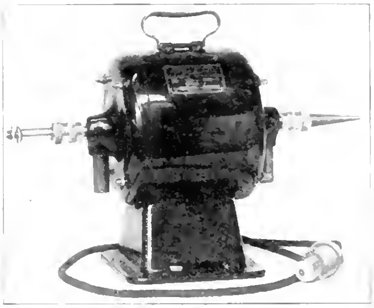
Great convenience is chief among the advantages of Westinghouse type DA motors. They can be located in almost any place where alternating current is supplied for electric lights and can be s'arted and stopped as simply as turning an electric light on or off. A small motor driven device can be located with sole reference to the convenience of the work, the light, ventilation, etc., and with little regard to the source of power. An ordinary flexible lamp cord with a connection plug serves to conduct the motor current for the smaller sizes from any convenient lamp socket, and the whole device, even while operating, can be moved about the room, as in case of carpet cleaners.

Perfect safety to the operator, to the motor and to the material being handled or the work being done is assured. All conducting parts are effectually covered so that electric shock is practically impossible. All moving parts, except a portion of the shaft necessary for driving, are so covered and protected that clothing or material cannot be injured. The motors are clean and free from oil throwing or dripping, and the work is not soiled. They are so extremely simple that even the most inexperienced person can operate them successfully and safely.

Economy is also a consideration in favor of small motor operated devices. Most people are surprised at the extremely low cost of operating a small Westinghouse motor. Many devices, which do more work than a full grown person can do by hand, can be motor operated at a cost of not over one half cent an hour. Moreover, current is taken only while the motor is operating, and the expense stops completely when the motor switch is opened.

The question of economy also extends to economy of space, which is sometimes an important matter. Motor operated devices occupy minimum space, and the output of a crowded shop or factory can be materially increased by substituting them for older methods of driving. This substitution can often be made in preference to enlarging the space.

In many a modern home the small motor has solved the servant problem either by making it possible to do without a servant or by making the work so pleasant and agreeable that good servants are glad to remain indefinitely. Small



Buffing, Polishing and Grinding Motor.

motors do the hard work, such as turning the washing machine and wringer, operating the carpet cleaner, floor polisher, dish washer, buffing and polishing wheels, etc. The sewing machine, a necessity in every household and formerly so trying to the strength of many housekeepers, can be operated with perfect satisfaction by a motor, and with practically no effort on the part of the operator except to guide the cloth.

The office man and banker have demonstrated to their entire satisfaction that motor driven machines will make mimeograph copies, fold the letters, seal and address the envelopes, stick the stamps, etc., much quicker and at less cost than it can be done by any other process, while at the same time registering the number of stamps used. Other machines will assort coins of different sizes, wrap them in packages of a given number each, and stamp the correct denomination and amount on the outside of the package. Motor driven adding machines also conduce to speed and accuracy.

Perhaps one of the most important of all the services rendered by small motors is that in which they add to human comfort by regulating temperature. Motor driven ventilating fans and blowers make living rooms more comfortable in summer by distributing cool air and in winter by distributing warm air. By their proper use in connection with the hot air heating system so much used in modern homes, a considerable saving in the cost of fuel can be effected, and the temperature throughout the rooms can be equalized.

Westinghouse type DA motors for single-phase alternating current circuits are extremely simple to operate. They are started and stopped by simply closing and opening an ordinary knife or snap switch. An occasional oiling is all the attention required under ordinary operating conditions during years of service.

These motors are built in capacities ranging from one twentieth to one-fourth horse-power, voltage 110 and 220, and

Motor Generator for Charging Storage Batteries, Ringing Bells, Etc.

frequencies 25, 40, 50 and 60 cycles; some capacities are also built for 133 cycles.

These ratings are for continuous service. The speed is very nearly constant, that of the several sizes ranging between the limits, 1200 and 3100 revolutions per minute. By the intervention of suitable gears or pulleys the motors can be adapted to almost any service requiring power within their capacities.

NEW CATALOGUES.

Fairbanks, Morse & Co. have just issued a general catalogue covering the complete line of goods carried by that concern.

The Benjamin Electric Manufacturing Company, 151 New Montgomery Street, San Francisco, announce that new Tungsten Bulletin No. 4, dated June 1st is just off the press and ready for distribution. It contains the latest Benjamin designs in Tungsten fixtures and is a condensed reference book of rare value for practical in-door and out-door lighting purposes. Copies will be mailed on application.

The Western Electric Company is distributing in pamphlet form a reprint from the June, 1907, issue of "Power" of an article by F. G. Gaesche with the title "First Rateau Regenerator Installed in America." It covers in detail description and test of the Rateau low-pressure turbine system installed at the works of the International Harvester Company, Chicago, Ill., together with illustrations, diagrams and data of great value.

The Westinghouse Company's publishing department has recently issued a very tasty little booklet entitled "The Mission of the Westinghouse Electric Toaster Stove." It is 3"x4" in size, uniquely bound in covers made in imitation of toasted bread. The reading matter tells in a narrative way of the great convenience of this little device and offers numerous suggestions as to its use for the busy man and woman in the handling of the food problem.

The Ball and Wood Company of Elizabethport, N. J., have just issued a very handsomely printed brochure descriptive of the Rateau-Smoot Turbine and Generators which should be found of great interest to engineers and others concerned in development in the field of power production. Besides being an excellent example of the printer's art, it contains information of great value, including illustrations of the apparatus of which it treats, pressure diagrams and outline diagrams showing the details of construction.

VOICE VIBRATIONS.

The volume of transmission produced by any transmitter is largely dependent upon the diaphragm area that is exposed to the sound waves. Another factor is how great a proportion of the diaphragm is allowed to vibrate freely.

In all solid back transmitters heretofore manufactured, the diaphragm is insulated from the transmitter front by a soft rubber gasket. When new, this gasket allows the diaphragm to vibrate freely throughout its entire surface. But, unfortunately, no soft rubber has been produced that will not, to a greater or less extent, harden with age. Therefore, as soon as this hardening takes place the vibrating area is limited to that portion not enclosed by the gasket. This surface is indicated by A, in Fig. 1.

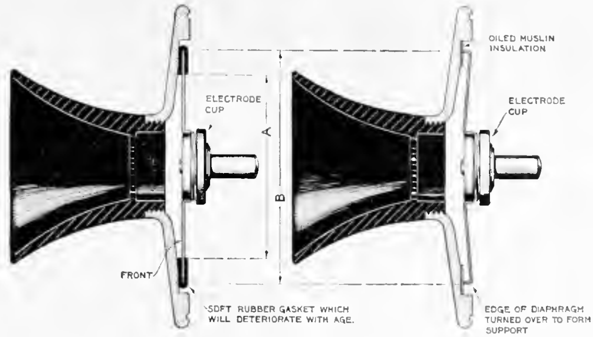


Fig. 1.

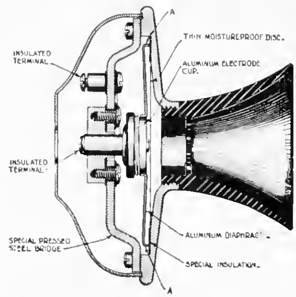


Fig. 2.

Furthermore, the hardening of the gasket contracts the rubber and throws the entire diaphragm out of adjustment. This deterioration often produces such a serious change that the surface of the electrode button does all the work that should be taken up by the entire diaphragm area. Then the deterioration of the gasket has a dampening effect upon the surface A.

To eliminate these opportunities for trouble, Wm. W. Dean, of the Dean Electric Company, Elyria, O., conceived the scheme of curling the edge of the diaphragm and insulating this part from the frame by a strip of oiled muslin. This material is as stable as steel and will stand an insulation test of 10,000 volts.

This produces the permanent vibrating surface B, Fig. 1, and since the voice vibrations strike the entire area, the volume of transmission is increased in proportion.

Another advantage of the substitution of muslin for rubber is the fact that the original adjustment remains permanent, since the muslin is practically indestructible. It is as permanent as the metal parts that compose the balance of the instrument.

In Fig. 2 and also in the right-hand portion of Fig. 1 it will be noticed that the newer diaphragm is cupped toward the front. This is done primarily to prevent any packing of the carbon particles in the electrode cup.

In operation these carbon granules become heated, and the heat is radiated into the diaphragm, which must expand. Because of the cupping of this diaphragm, it is impossible for it to expand in any other way than toward the mouthpiece of the instrument. This separates the front and back buttons of the electrode cup and absolutely prevents "packing."

This brings us to another point of excellence of the newer pattern as perfected by Mr. Dean: the new transmitter is self-regulating. It always gets the proper amount of current to give the highest grade of transmission regardless of the length of line of the voltage of the system. Furthermore, the consumption of power is reduced during the time the subscriber is listening, to two thirds the amount required while talking.

This feature is of special advantage in local battery service where the voice current is furnished by dry cells. Even poor dry batteries will last longer and give a greater volume of transmission, during their entire life.

By again referring to Fig. 2, it will be noted that an arrow points to a line in the cross sectional drawing representing a thin moisture proof disk. This part seals the front of the transmitter and renders it absolutely moisture proof. This advantage is effected without decreasing the volume of transmission in any way. In fact, this feature serves to increase the sensitiveness of the diaphragm itself.

It should be noted that all of the parts in what is generally known as the Dean Indestructible Transmitter are constructed from non-deteriorating materials. The bridge holding the insulated terminals and the electrode button, is made of special pressed steel. A cast bridge is liable to shrinkage and breakage. The mouthpiece is also of steel drawn from cold metal. This is one of the latest Dean improvements that has just been marketed.

Possibly the most interesting feature of the new pattern is its simplicity. A comparison between it and the instruments manufactured before the introduction of competition in the telephone business, indicates how valuable competition has been to the industry at large. Readers familiar with early telephone work will remember the comparatively clumsy diaphragms that seemed to be constructed for no other purpose than to "buckle." Later on the adoption of carbon granule electrode chambers seemed conducive to very poor results through "packing." The absolute elimination of such difficulties and the many other advantages of competition are very gratifying indications of the advance in the art of manufacturing telephone equipment.

GAS EXPOSITION IN OAKLAND.

A very interesting exposition has been held during the past two weeks in the Arcade Building, corner Twentieth street and San Pablo avenue, Oakland, under the auspices of the Oakland Gas, Light and Heat Company.

The exposition included every device used in lighting, cooking and heating by gas, demonstrations being given during the exposition together with cooking lessons by experts in the handling of the gas range.

The booth of the Welsbach Company was particularly effective, as it included a complete installation of their various forms of mantle lights with a variety of designs in glassware and an actual demonstration of the consumption of gas with the Welsbach light as compared with the old type of open burner.

NEWS NOTES

INCORPORATIONS.

WALLA WALLA, WASH.—Washington Traction Company, $3,500,000; Gilbert Hunt and others.

PORTLAND, ORE. Inland Oregon Electric Railroad Company, $10,000,000; Mark W. Gill and others.

SPOKANE, WASH.—Mosso-Berry Electrical Company of Spokane, $10,000, by H. L. Tinling, T. P. Mosso, F. O. Berry, and T. A. Allen.

SAN FRANCISCO, CAL.—Articles of incorporation of the Economic Gas Company of Santa Clara have been filed. The corporation is capitalized at $1,500,000. The directors are, D. O. Druffel, Henry P. Eberhard, and Nicholas Bowden.

NORTH YAKIMA, WASH.—The Eagle Valley Development Company is the name of a corporation organized to do mining, milling, irrigation, manufacture electric power, construct waterworks, pumping stations, light and power plants, etc., with capital stock of $40,000, by Owen Jones, Harry V. Bonniwell and Reuben L. Garrett.

SAN FRANCISCO, CAL.—Articles of incorporation of the Win Power Company have been filed. The company will deal in electricity, gas and water power. The directors are J. M. Agar, Ferdinand Butterfield and Mr. Lotspeich, the first two of San Francisco and the last named of Downieville. The corporation is capitalized at $499,800, of which $300 has been subscribed.

SALT LAKE CITY, UTAH. The Independent Electric Company of this city, to deal generally in electric supplies; capitalization, $20,000, divided into 2000 shares of $10 each. Joseph F. Smith, Jr., president; Heber C. Iverson, vice-president; Lon J. Haddock, secretary, E. Chandler, treasurer; Oscar G. Hemenway, George C. Smith, W. N. Williams and R. S. Siddoway, additional directors.

FINANCIAL.

ROSEBURG, ORE. The City Council has sold the $25,000 bond issue to Douglas County Bank, at par.

McMINNVILLE, ORE. A special election will be held this week for the voting of the $30,000 additional water and light bonds.

PORTALES, N. M. An election for a $75,000 bond issue for municipal water and electric light plants was carried by a large majority.

LOS ANGELES, CAL. Stockholders of the Alamitos Water Company have voted to issue bonds in the amount of $200,000 preliminary to enlarging the system.

SUNNYSIDE, WASH. At the election on Saturday to decide whether bonds should be issued to meet the expense of water works and other improvements the vote stood 8 to 1 in favor of the bonds.

UNION, ORE. The Council has passed an ordinance authorizing the issuance of bonds in the sum of $25,000 for putting in an electric light plant, and calling an election on August 16 to vote on the proposition.

COVINA, CAL.—The Covina Valley Gas Company, under reorganized management has succeeded in selling bonds to the extent of $50,000 and will immediately begin operations extending lines to Glendora and Azusa.

NORTH YAKIMA, WASH.—The sum of $70,000 has been subscribed by the people of this county toward assisting the Yakima Valley Transportation Company in extending its electric lines into various valleys around the city.

HILLSBORO, ORE.—The City Council has accepted the offer of a company of capitalists for the purchase of the city water and light plant for $15,500 and a 25-year franchise was granted. C. E. Lytle of this city is one of the promoters.

TUCSON, ARIZ.—A company headed by John Mets of Tucson has purchased a controlling interest in water works system of Benson and has purchased also the Benson gas works. The company will soon install an electric lighting plant.

PALO ALTO, CAL.—The Palo Alto bond election last week, which involved several propositions to increase the bonded debt of the town, resulted in the passage of three propositions and the defeat of four. The one that carried by the largest vote was the proposition to acquire and construct an automatic fire-alarm system at a cost of $3,500. The other two successful proposals were, first, to establish a modern street lighting system at a cost of $3,500, and second, to expend $7,000 in constructing a water tank for the municipal and lighting plant.

MADERA, CAL. The municipal water and sewer bonds have been sold by the city trustees to G. G. Blymeyer & Co., of San Francisco, at a premium of $7350. James H. Adams & Co. of Los Angeles bid $7434, but their bid was conditional upon everything being correct and subject to the approval of their attorney. The advertisement called for an unconditional bid and as Blymeyer & Co.'s bid complied with the request they were given the bonds. The other bidders were: N. W. Halsey & Co., $6,577.50, J. C. Wilson, sewer bonds, $2,507.50; Barroll & Co., $6,705; W. R. Staats & Co., $6,604.

TRANSPORTATION.

ESTACADA, ORE. The Portland Railway, Light & Power Company has decided to erect a new depot here.

WALLA WALLA, WASH.—The County Commissioners will, on June 8th, hear the petition of the Walla Walla Valley Traction Company for the construction and maintenance of an electric line on Yellow Hawk avenue.

LOS ANGELES, CAL.—The City Council has passed Ordinance No. 208, granting to M. J. Nolan a franchise for the construction and maintenance of an electric railway along a portion of Washington street in this county.

SAN BERNARDINO, CAL.—The City Council, on request of Attorney J. W. Stephenson in the matter of a franchise for an electric railway into the N. W. residence district, was laid over two or three weeks to give the traction people an opportunity to meet with the petitioners.

LOS ANGELES, CAL.—The City Council has passed Ordinance 206 granting to P. Janss the right to construct and for a period of 20 years to maintain a single or double track railway along Stephenson avenue and Whittier Road in the county of Los Angeles.

TACOMA, WASH.—Dibble & Hawthorne, railway contractors, Bank of Commerce Building, Tacoma, have been awarded the contract for double tracking and relaying the tracks of the Pacific Traction Company for the street car lines on paved streets in this city. The cost will be $45,000.

FRESNO, CAL.—There was only one tender offering a cash bonus for the advertised franchise of the Hanford-Fresno and Summit Lake Interurban Railway covering connecting links across the county roads on the proposed line of the electric road. That bid was F. S. Granger's and the franchise was granted to him.

CITY OF MEXICO, MEX.—Locating Engineer A. V. Nesbitt of the Dr. F. S. Pearson's railroad, and other interests, has left Mexico City for Amecameca, where he will meet a party of engineers to make final surveys for a proposed electric railroad from Mexico City to Pueblo.

MEDFORD, ORE.—H. H. Harris of the Butte Falls Lumber Company will leave for Portland and the East next week, when he will order materials for the construction of the proposed electric line of the company from Medford to Butte Falls. The survey is completed and work is to begin at once.

TACOMA, WASH.—The Pacific Traction Company's experiment of laying street car rails on the concrete base of the street paving has failed to work and the track on the paved streets is now being torn up by Dibble and Hawthorne to put in ties. The experiment cost $25,000 and the track has been down less than two years.

ASTORIA, ORE.—The Astoria Electric Company has elected the following directors: E. C. Mitchell, S. S. Gordon, G. C. Flavel, R. C. Prael, artin Foard, F. C. Sykes and J. D. Mortimer, E. G. Mitchell was elected president; S. S. Gordon, vice-president and D. F. McGeer, secretary. The matter of extending the service and improving and overhauling the system was decided on. The line will be extended to near Hammond mill and the whole system placed in first-class condition. Over $10,000 will be spent.

PORTLAND, ORE.—Several hundred thousand dollars will be expended by the Oregon Electric Company on its present lines and on extensions during the year. Officials of the constructing, operating and engineering departments of the road are making a tour over the lines, preparatory to laying out the work to be undertaken. Members of the party were not inclined to talk, but enough could be learned to make it apparent that the expenditure of a large sum of money, probably $1,000,000 or more, was assured.

SACRAMENTO, CAL.—Actual construction work was commenced by the Sacramento and Sierra Railway this week at Orangevale, Sacramento County, when 20 teams with plows and scrapers were put to work under the direction of Engineer Graham. More teams will be put to work at that point and at other points between Sacramento and Lake Tahoe in a few days, and the work now started will continue until the railroad is completed through the timber belt in El Dorado County, which it is being built to tap. The road is financed by C. A. Smith and other millionaire lumbermen, and it has been making all its preliminary arrangements quietly and systematically. Land has been acquired in Sacramento for the location of factories at which the materials from the forests of yellow pine and sugar pine in the Sierra will be worked up into various finished products.

TRANSMISSION.

WENATCHEE, WASH.—The Council has granted a franchise to the Entiat Power Company. Power must be delivered in the city by December, 1909.

SPRINGFIELD, ORE.—The McKenzie Valley Irrigation & Power Company was granted a franchise to furnish electric power and light for a period of 50 years.

BELLINGHAM, WASH.—The Skagit Power Company has been granted a 50-year franchise by the government and will erect a 60,000 h. p. plant in the reserve on the Skagit River.

OROVILLE, WASH.—A. M. Dewey has started a crew of surveyors to laying out a site for a power house, dam and canal. The site is on the Similkameen River seven miles northwest of here and 3000 horsepower will be developed.

SUMPTER, ORE.—The Fremont Power Company is preparing to raise its Olive lake dam 25 feet, which will clearly double the capacity of the reservoir. Work will commence as soon as conditions at that altitude will permit. Right of way for the transmission lines will be cleared this summer.

LOS ANGELES, CAL.—The Copper Queen Mining Company is preparing to double the capacity of the electric plant at its mines near Copper Creek, Ariz. Another 300 horsepower engine will be installed.

RED BLUFF, CAL.—County Surveyor W. F. Luning has filed on 12,000 inches of the water in Mill Creek to be diverted in township 27, North, Range 2 East and used to generate electric power. The ditch will be 20 feet wide on top and 14 feet on the bottom and six foot deep. The flume will be 12 feet wide with sides seven feet high.

HAWTHORNE, NEV.—An electric power project has been financed by leading men of this camp and a syndicate has already purchased a chain of lakes emptying into Lavining and Rush creeks, near Mono Lake, Cal., 30 miles from Bowie. The work of constructing a power plant will be rushed. J. S. Cain, Johnnie Miller, J. E. Adams and others of St. Louis are behind the project.

FRESNO, CAL.—A. G. Wishon, with a party of engineers, including A. E. Balch, F. S. Newman, William Storrow and others from the southern part of the State, have gone to the mountains to inspect the site of proposed improvements and enlargements of the proposed improvements of the power plant on the San Joaquin. The proposed enlargements include the construction of a large dam, and a great increase of the plant.

SANTA BARBARA, CAL.—The Board of Public Works is receiving sealed bids for two 6-inch rough square casing sewerage pumps fitted with two-passage sewerage impellors, two 15-horsepower 1200 revolutions per minute 60-cycle General Electric induction motor 220 volts, 2 automatic starting compensators for 3-phase system of General Electric Company, each compensator being accompanied with single pole float-switch copper ball float with extended road, pulleys and chain.

SACRAMENTO, CAL.—The Sacramento Valley Power Company has been organized to take over the property of the Northern Light and Shasta Power Companies, consisting of plant on South Cow Creek (2000 horsepower) and plant on Snow Creek (1600 horsepower), with transmission lines extending to Redding, Shasta County, California. Additional water rights (10,000 undeveloped horsepower for the system) have been purchased and plans are now being prepared to extend the transmission lines.

SAN FRANCISCO, CAL.—W. H. Dohrmann, formerly auditor of the Hotel St. Francis, returned last week from Chihuahua, Mexico, where he is general manager of a large power system, on his way to New York to confer with experts upon the best way of increasing the capacity of the different plants under his control. At present the three plants of which Dohrmann has charge are producing about 2,000 kilowatts of electricity, but he says that the country is developing so rapidly and there is such a demand at present for power that he can find sale for twice that amount of energy in a very short time.

SAN FRANCISCO, CAL.—Louis T. Samuels and Louis Friedlander have leased the building to be erected on the north line of Sutter street, 68 feet west of Stockton, to the Metropolitan Light and Power Company for five years on private terms. This section seems to be particularly favored by the public service corporations. There are now in the immediate neighborhood the San Francisco Gas and Electric Company, Spring Valley Water Company, City Electric Company, Pacific States Telephone & Telegraph Company, Metropolitan Light and Power Company, Home Telephone Company and Pacific Gas and Electric Company.

ILLUMINATION.

UPLAND, CAL.—J. R. Anderson has secured a franchise for a gas plant.

KAMLOOPS, B. C.—The proposition to install an electric light plant was carried at the recent election.

AUBURN, CAL.—Wm. Mayer contemplates installing an electric plant for lighting and other domestic purposes.

SEATTLE, WASH.—The Council has passed a resolution providing for the installation of cluster lights along Union and Pike streets.

LAFAYETTE, ORE.—The City Council has granted a franchise to the Lafayette Light & Water Co. to supply this place with electric lights.

DOWNEY, CAL.—J. R. Gordon, proprietor of the Downey Light, Power and Water Company, will commence work at once on extension of his line to Rivera.

EL CENTRO, CAL.—Work is to be begun next week on the plant of the Imperial Valley Gas Company, which is to be located here. W. F. Holt is backing the enterprise.

REDWOOD CITY, CAL.—The United Gas & Electric Company has been granted permission to lay gas mains on Franklin street from Jefferson to Madison and on Madison Street to the county road.

LOS ANGELES, CAL.—The Board of Public Works is receiving sealed bids for furnishing the city four 20 horsepower and four 10 horsepower direct current motors in accordance with specification No. 73 on file with the board.

HERMISTON, ORE.—The City Council is considering a proposition from the Rose City Electric Construction Company of Portland, for a 20-year franchise for an electric light and power plant in this city to cost in the neighborhood of $15,000.

LOS ANGELES, CAL.—The Janss Investment Company intends to furnish electricity for lighting purposes in the section just east of Indiana street. The company is now supplying residents of this section with water and plans to use the surplus power developed at its water plant to generate electricity.

CENTRAL CITY, NEB.—A move is on foot to submit the question of voting bonds for a municipal electric lighting plant in Central City, and there is every indication that the measure will carry. The town is at present lighted by a gasoline plant, which gives good service, but there is a demand for electric lights.

CHEHALIS, WASH.—The MacArthur Gas and Power Company is the name of the company that will be formed in Tenino during the week for the purpose of developing the gas apparatus MacArthur has invented to manufacture gas. It is the intention of the company to put in a big plant in Tenino to manufacture the machinery necessary for installing plants of this kind.

HOLLY, COLO.—An electric lighting system of the latest pattern with arc lights and numerous incandescents will be installed in Holly in the next thirty days. The City Council so agreed, and the order for all the material, amounting to nearly $5000, was given to the Western Electric Company. The generator will be applied to the water pump from the water works, consequently Holly's electric light supply will be a most inexpensive luxury.

MOUNTAINHOME, IDAHO.—Seymour H. Bell has arrived from Portland and has purchased the local electric light plant at sheriff's sale. He states that the plant will be fully repaired and placed in running order at once. An expert armature winder will go over the plant carefully and if the present machinery cannot be put in first class condition, a new one will be ordered and shipped at once.

WATERWORKS.

LEAVENWORTH, WASH.—The Tumwater Light & Water Company will build a power line to Peshastin for pumping purposes.

SAN DIEGO, CAL.—The Council has adopted ordinances providing for the laying of water pipes in Hamilton and State streets.

COTTONWOOD, IDAHO.—A contract has been let to the Fairbanks, Morse Company by the Cottonwood Water Company for a pumping plant and 6,000 feet of water pipe.

LOS ANGELES, CAL.—The Council has authorized the Board of Public Works to purchase a steam shovel to cost $8,000 for acqueduct work on the Owens River system.

LOS ANGELES, CAL.—The Board of Public Works is receiving sealed bids for furnishing materials and supplies consisting of steel ribs for tunnel forms in accordance with specification No. 168B on file with the Beard.

CHICO, CAL.—The Chico Water Suppy Company has recognized the growth of Chico and the demand for increased service. Work has been started on a well at the corner of Fourth and Locust streets, South Chico, to supply better service in that suburb.

YERINGTON, NEV.—F. W. Fairbanks returned from Reno to San Farneisco last week with the news that the city of Yerington was practically assured of a water system. A company has been organized in Reno with J. E. Gignoux as president, H. W. Huskey, vice-president and secretary, and Fred Stadtmuller, treasurer. The company will build waterworks here.

OAKLAND, CAL.—The Niles Water Company has asked for permission to lay a water pipe in the streets of Niles, beginning near Valley Hills and ending at the western end of the town. The Spring Valley Water Company has asked to withdraw its application and bonds filed in October, 1908, for permission to lay a pipe line along the county road from Pleasanton to Sunol, on the ground that it had made arrangements for a private right of way.

OIL.

SACRAMENTO, CAL.—A branch plant of the Union Oil Company to distribute not only for Northern California but for the State of Nevada is to be established in Sacramento. The company has purchased eight acres in the southern limits of the city and will erect works there. It also plans to operate its own line of river steamers between here and San Francisco.

BAKERSFIELD, CAL.—A large number of prominent independent oil producers attended the stockholders meeting of the Kern River and Coalinga Independent Oil Agencies last week and ratified the proposition formulated recently to build a pipe line from Bakersfield and Coalinga to tide water. L. P. St. Clair, president of the Independent Producers' Agency; S. W. Morsehear, president of the Coalinga Agency; H. H. Welsh of Fresno and M. V. McQuigg of Los Angeles, who are members of the agencies' executive committee, were given power to go ahead with the work. The securing of right of way, making surveys, etc., will begin forthwith, and it is expected to begin work by August 1, 1909. The estimated cost of the pipe line is $3,000,000, and the independent Transportation Company, with a capital of $10,000,000, of which $7,500,000 will be paid in, will probably be organized at once. By the contract with the Associated, which the Independents now have, the Associated handles daily 16,000 barrels of oil, leaving a surplus of 8,000 barrels of crude oil. By contract the Associated has to store the Kern River surplus in its storage tanks, while at Coalinga no provision is made for the surplus. The agencies therefore voted to have steel storage tanks built at Coalinga for this surplus, which is estimated at 3,500 barrels daily. These tanks, costing hundreds of thousands of dollars will later be taken over by the new pipe line company.

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Elec. Appliance Co., "Cutter."
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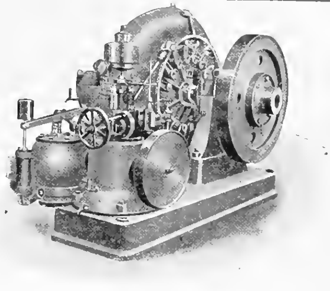

INDEX TO ADVERTISEMENTS

Sterling Elec. Co.
Western Elec. Co.

ASBESTOS

Johns-Manville Co., H. W.

AUTOMOBILE ACCESSORIES

American Eveready Co., "Ever Ready."

BATTERIES

Dry Batteries
American Ever Ready Co. "Ever Ready" and "Crescent."
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Standard Electric Works, "Standard."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

Dry Battery Holders
Brooks-Follis Elec. Corp.
Stanley & Patterson, Inc., "Patterson."

Medical Batteries
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Electro - tonic," "Vetter."

Wet Batteries
Brooks-Follis Elec. Corp.
Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

Storage Batteries
Elec. Storage Battery Co.
Westinghouse Machine Co.

BELLS

Electric Bells
Brooks-Follis Elec. Corp.
Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

Electro-Mechanical Gongs
Brooks-Follis Elec. Corp.
Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.

Magneto Bells
Brooks-Follis Elec. Corp.
Dean Electric Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Switchboard & Supply Co.
Standard Electric Works, "C. & S."
Western Electric Co.

BOILERS

Henshaw, Bulkley & Co.
Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, "Edge Moor."

BOXES

Floor and Outlet
Krantz, H., Mfg. Co.

Junction Boxes
Krantz Mfg. Co., H.

Wall Boxes
Brooks-Follis Elec. Corp.
Benjamin Elec. Mfg. Co.
Bossert Electric Construction Co., "Bossert."
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Stanley & Patterson, Inc., "Simplex."
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Brooks-Follis Elec. Corp.
Stanley & Patterson, Inc., "Imperial."
Sterling Elec. Co., "Equipoise."
Western Electric Co.

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Kierulff, B. F., Jr. & Co., "Cutter."
Pierson, Roeding & Co.
Western Elec. Co., "Fletcher."

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Gas Lighting Burners

Edwards & Co.
Electric Goods Mfg. Co., "Advance."
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Krantz, H., Mfg. Co.

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Submarine and Lead-Covered

Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
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Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

Paper Insulation

Belden Manufacturing Co.
Western Electric Co.

Telephone Cable

Dean Electric Co.
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CARBONS

Arc Light Carbons

Brooks-Follis Elec. Corp. "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The "I-T-E," "Dalite."
Ft Wayne Electric Works.
General Electric Co.
American Ever Ready Co.
Kierulff, Jr., & Co., B. F. "Hartman."
Pacific Electric & Manufacturing Co.
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLAMPS

Ground Clamps.

Belden Manufacturing Co.
Bossert Electric Const. Co.
Chase - Shawmut Co., "Shawmut."
General Electric Co.
Paiste Co., H. T. "Perma-Effect."
Thomas & Sons Co., R.
Weber Elec. Co., H. D.

CLEATS.

Fibre Cleats

Blake Signal & Mfg. Co.
Brooks-Follis Elec. Corp.

Porcelain Cleats

Brooks-Follis Elec. Corp.
General Electric Co.
Pass & Seymour
Standard Electrical Works, "Standard."
Star Porcelain Co. Sears, general sales agent.
Western Elec. Co., "Thomas."

COILS

Armature and Field Coils

Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Deltabeston."
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Electric Goods Mfg. Co.
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COMPOUNDS

Boiler Compounds

Dearborn Drug & Chemical Works
Johns-Manville Co., H. W., "Magic."

CONDUIT

Flexible Conduit

American Circular Loom Co., "Circular Loom."
Sprague Electric Co., "Greenfield."
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Rigid Conduit

American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct," "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roebling's Sons Co., J. A., "Navalite."
Sprague Electric Co., "Iron Armored."
Telephone & Elec.Equip.Co. "Economy."

Underground Conduit

American Cross Arm Co., "Walworth & Neville."
Johns-Manville Co., H. W., "J-M."
Pierson, Roeding & Co., "Fibre."
Roebling's Sons Co., J. A., "Bituminized Fiber."
Western Electric Co. "Walworth & Neville."

CONNECTORS

Cable Connectors

American Ever Ready Co. "Bulldog."
Belden Manufacturing Co.
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CORD

Flexible Bell Cord

Belden Mfg. Co.
Brooks-Follis Elec. Corp.
General Electric Co.
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Roebling's Sons Co., J. A.
Simplex Elec. Co.
Western Electric Co.

Lamp Cord

Belden Mfg. Co.
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "Paranite."
General Electric Co.
Okonite Co., The, "Okonite."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Roebling's Sons Co., John A.
Safety Ins. Wire and Cable Co.
Simplex Elec. Co.
Standard Und. Cable Co.
Western Elec. Co., "Victor."

Telephone Cord.

Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Dean Electric Co.
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Safety Ins. Wire and Cable Co.
Simplex Elec. Co.
Western Elec. Co., "Victor."

CROSS ARM BRACES.

Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co.

CLUSTERS

Fixture Clusters

Benjamin Electric Mfg Co. "Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbell."

CUT-OUTS

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Bryant Electric Co.
Ft. Wayne Elec. Works.
General Electric Co.

Incandescent Cut-Outs

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
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Perkins Elec. Swch Mfg Co.
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Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

D. C. Dynamos

Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co
Western Electric Co
Westghse Elec. & Mfg. Co

ELECTRIC NOVELTIES

American Ever Ready Co "Ever Ready."

ENGINES

Gas and Gasoline Engines

Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Kierulff, B. F., Jr & Co., "American Diesel."
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Westinghouse Machine Co

Marine Engines

Standard Engineering Co., "Engberg."

Steam Engines

Moore & Co., Chas. C.
Henshaw, Bulkley & Co.
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FANS

A. C. Portable Fans
Brooks-Follis Elec. Corp.
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Standard Electric Works, "Jandus."
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Westghse Elec. & Mfg. Co.

D. C. Portable Fans
Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Sprague Electric Co., "Lundell."
Standard Electrical Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

A. C. Ceiling Fans
Brooks-Follis Elec. Corp.
Standard Elec. Works, "Jandus," "Century."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

D. C. Ceiling Fans
Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
General Electric Co.
Sprague Electric Co., "Lundell."
Standard Elec. Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

Exhaust Fans
Brooks-Follis Elec. Corp.
General Electric Co.
Standard Elec. Wks., "M. A. Co."
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co.

FIXTURES

Ceiling, Bracket and Desk Fixtures
Benjamin Elec. Mfg. Co.
Dale Co

Marine Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.
Electric Appliance Co.
Sterling Electric Co.

Show Case Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.
Johns-Manville Co., H. W., "Linolite."

Stage Fixtures
Chase-Shawmut Co.,"Shawmut."

FLASHLIGHT (Pocket)
American Eveready Co., "Ever Ready."

FUSE MATERIAL

Enclosed Fuses and Fittings
Bryant Electric Co.
Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co., "Union."
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W., "Noark."
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

Fuse Boxes
Including Service Boxes, Subway Boxes and Junction Cut-Outs for use with enclosed fuses.
D. & W. Fuse Co., "D. & W."
Johns-Manville Co., H. W., "Noark."

Fuse Wire and Links.
Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co.
General Electric Co.
Pierson, Roeding & Co., "Aluminum."

Miscellaneous Fuses
Bryant Electric Co.
General Electric Co.

Paiste, H. T. Co., "H. & L."
Weber Elec. Co., H. D. Sears, Gen'l Sales Agent

Telephone Fuses
Dean Electric Co.
D. & W. Fuse Co.
Kierulff, B. F., Jr. & Co. "Sterling."
Standard Elec. Works "Couch & Seeley."
Western Electric Co.

GOVERNORS.

Water-Wheel Governors
Pierson, Roeding & Co. "Lombard."

GUARDS.

Wire Lamp Guards.
Benjamin Electric Mfg. Co. "Can't Break," "Protectalite."
Hubbell, Harvey
Krantz, H., Mfg. Co.

HANGERS

Cable Hangers
Chase-Shawmut Co., "Boston."
Kierulff, B. F. Jr. & Co. "National."
Standard Underground Cable Co., "Norlyke Support."

HEATING MATERIAL.
Including Cooking Utensils Soldering Irons, Sad Irons, Etc.
Brooks-Follis Elec. Corp.
Elec. Appliance Co. "American."
General Electric Co.
Johns-Manville Co., H. W. "Electrotherm."
Simplex Elec. Heating Co. "Simplex."
Vulcan Elec. Heating Co. "Vulcan."
Westghse Elec. & Mfg. Co.

HOODS.

Street Hoods
Elec. Appliance Co., "Cutter."
Ft. Wayne Elec. Works.
General Electric Co.
Kierulff, B. F., Jr. & Co. "Culter."
Western Elec. Co., "Fletcher."

INSULATORS

Glass Insulators
Brookfield Glass Company "Brookfield."
Elec. Appliance Co., "Hemingray."
Pierson, Roeding & Co. "Locke Triple Petticoat."
Roebling's Sons Co., John A., "Knowles."
Standard Electrical Works "Standard."
Western Elec. Co., "Brookfield."

High-Tension Insulators.
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co. "Ohio Brass."
Pass & Seymour.
Pierson, Roeding & Co. "Locke."
Roebling's Sons Co., John A., "Lima."
Thomas & Sons Co., R.
Western Elec. Co., "Thomas."

Porcelain Insulators
General Electric Co.
Johns-Manville Co., H. W.
Pass & Seymour
Pierson, Roeding & Co. "Locke."
Standard Electrical Works "Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Electric Co., H. D. Sears, gen'l sales agent
Western Elec. Co., "Thomas."

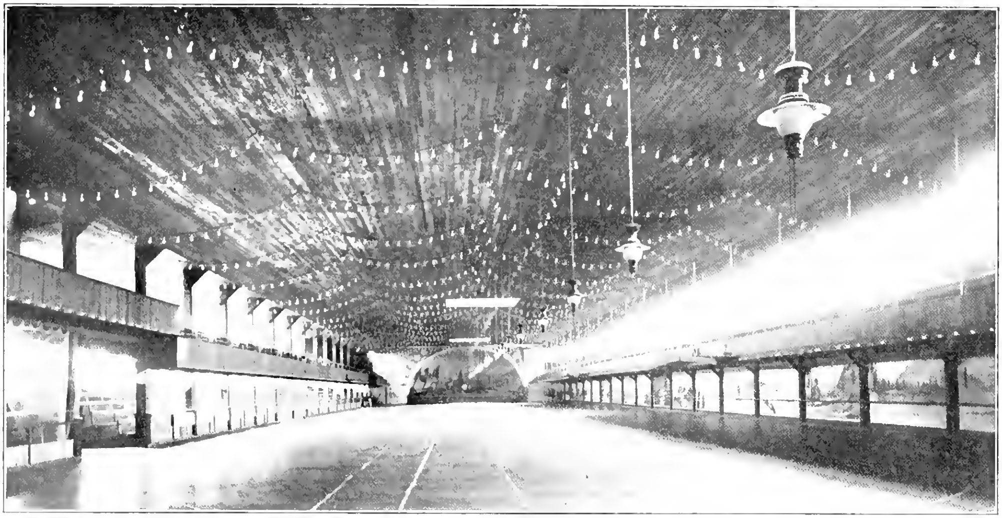
Wood Knobs
Blake Signal & Mfg. Co.

INSULATING MATERIAL
Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co. "Di-electric."

JOURNAL OF ELECTRICITY
POWER AND GAS

Devoted to the Conversion, Transmission and Distribution of Energy.

VOLUME XXII. SAN FRANCISCO, JUNE 12, 1909. NUMBER 24



The Auditorium, San Francisco. In this building the Mechanics' Fair will be held during the week beginning June 14th.

NATIONAL ASSOCIATION STATIONARY ENGINEERS.

FRED J. FISCHER,
National President.

The National Association of Stationary Engineers, whose California subsidiary association meets in annual convention at San Francisco during the coming week, represents the highest type of that great body of progressive men, the steam engineers. The object of the association is primarily educative and incidentally fraternal. Organized in 1882, it has successfully waged a campaign of technical enlightenment of its members that has been potent in advancing the art of steam engineering to its present high standard. In California there are eight subordinate associations with several more applying for admission at this convention. In Arizona there are four, in Colorado six, in Oregon two and in Washington four, which hold week'y meetings to hear talks on all the varied apparatus comprising a modern power plant. It discountenances any project disturbing harmonious relations between employer and employee.

With such laudable purposes in view the association is worthy of the active support of everyone interested in steam engineering. Such support has been lent by many of the great machinery manufacturers of the country who have prepared exhibits of late developments for the Mechanics' Fair to be held in conjunction with the convention. Their local representatives are to be commended for their zeal in preparing interesting displays in such a short time. In consequence this fair will be the most comprehensive and complete exhibit of power machinery ever held in the West and it merits careful inspection. Attendance at the meetings and fair will also show that the welcome to visiting delegates is as sincere as it is hearty.

WELCOME TO THE ENGINEERS.

H. D. Saville.

The local members of the National Association of Stationary Engineers have made very complete preparations for the care and entertainment of the visiting members of the order who will be in attendance at the sixth annual convention to be held in San Francisco during the week beginning June 14th.

The various committees working under the direction of State President Saville have spared neither effort nor expense to make this the banner convention in the history of the association.

In addition to the arrangements for the social entertainment of the members and their families a most interesting program has been provided for the business session which, in connection with the machinery and supply exhibits of the Mechanics' Fair to be held in conjunction with the convention, should prove unusually instructive.

Through the medium of the "Journal of Electricity, Power and Gas," President Saville extends the following welcome to the visitors:

To the Delegates and Members of the National Association of Stationary Engineers

Dear Sirs and Brothers:

The local committee for the arrangement of the details of our sixth annual convention, to be held in San Francisco during the week of June 14th to 19th, inclusive, have about completed their labors, with the result that the care and comfort of all those attending the convention have been arranged for.

The Mechanics' Fair which will be given in conjunction with the convention I believe, will well reward any person mechanically inclined who will visit and carefully inspect it. The fullest opportunity will be afforded all to view the wonderful progress that has been made in rearing the new city, Phoenix like, on the ruins of the disaster of 1906, and the many points of natural interest surrounding the bay and city will be visited.

I believe this will be a real convention—one in which the foundation work of our institution, the education and general uplift of these members, will receive the attention that so important a question deserves, and in order that this may be accomplished, certain days have been especially assigned for pleasure and others for business, and I hope that every delegate and as many of the members as can possibly do so, will attend and actively participate in all sessions of the convention.

The following program has been outlined, subject to change:

Monday, June 14th, 8 P. M.—Opening exercises of the fair, in which there will be an address of welcome by the Mayor and an invocation by the Rev. Wm. Rader. The fair will be started by the pressing of a button by the Mayor.

Tuesday, June 15th, 9 A. M.—Opening of the convention. 2 P. M.—Convention in session. 8 P. M.—Lecture on fans and ventilation, by R. B. Guernsey, M. E.

Wednesday, June 16th, 9 A. M.—Sight-seeing trip. 8 P. M.—Lecture by W. F. Durand, engineer of the Department of Mechanical Engineering, Leland Stanford Jr. University.

Thursday, June 17th, 9 A. M.—Convention in session. Afternoon rest period.

Friday, June 18th, 9 A. M.—Sight-seeing trip. 8 P. M.—[illegible]

Saturday, June 19th, 9 A. M.—Convention in session. Noon—[illegible] 8 P. M.—Banquet.

[illegible] to all delegates and friends on behalf of the Association in San Francisco our heartiest good wishes, I remain,

Yours fraternally,

H. D. SAVILLE, State President.

LIST OF EXHIBITORS AT THE MECHANICS' FAIR.

We give below a complete list of the exhibitors with the number of the booths they will occupy at the Mechanics' Fair to be held at the Auditorium, Page and Fillmore streets, San Francisco, from June 14th to June 19th, inclusive, under the auspices of the National Association of Stationary Engineers, and in connection with the annual convention which will be held during that week by the Association.

Exhibitor.	Booth No.
Allis-Chalmers Co.	227, 228.
Bird-Archer Co.	265.
Brooks-Follis Electric Corp.	96, 97.
Bowers Rubber Co.	104, 105, 106.
Boyd & Moore	93.
Braun, Knecht & Helman Co.	12.
Byron Jackson Iron Works	100, 101, 102, 103.
Callahan Co., John	123.
California Compounding Co.	7.
California Hydraulic Engineers	126, 174, 175.
Cook Belting Co., H. N.	191, 192.
Compressed Air Machinery Co.	196, 197, 259, 260.
Crane Company	134, 135, 165, 166.
Cyclops Iron Works	215, 210.
Doak Gas Engine Co.	208, 209, 245, 246, 247.
Dearborn Chemical Co.	189, 267.
Dow, Geo. E. & Co.	211, 212, 213, 242, 243, 244.
Dunham, Carrigan & Hayden Co.	1.
Farnst & Fearis Brazing Co., Wm.	80.
Eccles & Smith Co.	184, 185, 186, 187.
Fairbanks-Morse Co.	198, 199, 200, 257, 258, 256.
Fess System Co., Inc.	226, 229.
Fuller Co., W. P.	131.
Garlock Packing Co.	172, 173.
General Electric Co.	119, 120, 181, 182.
Greenbergs' Co., M.	22.
Herzog & Dahl Co.	201.
Henshaw, Bulkley & Co.	214, 241.
Harron, Rickard & McCone	250, 251, 252.
Gorham Rubber Co.	107, 108.
International Chain Saw Co.	202, 203, 253, 254, 255
Johns-Manville Co. H. W.	8, 9.
John Finn Metal Works	125, 176.
Johnson Co., E. H.	132.
Kalas & Bennett Co.	79
Keystone Chemical Co.	13.
Krogh Mfg. Co.	205, 206.
Lally Co.	15, 16, 17, 18.
Lord Co., Geo. W.	216, 239.
Lukenheimer Co.	178.
Marshall Newell Supply Co.	94, 95.
Mechanical Dust Suction Co.	109, 110, 111.
Moore, Chas. C. & Co.	6, 121, 180.
Messe-Gottfried Co.	248, 249.
Moorehead Mfg. Co.	11.
Motor Car Service	204
Moulthrop & Elsasser	10.
New York Belting & Supply Co.	138, 162.
Phoenix Tool and Valve Co.	179
Pacific Suction Cleaner Co.	137, 163.
Power Specialty Co.	127.
Plant Rubber & Supply Co.	193, 263, 264.
Pacific Hardware & Steel Co.	150, 151.
Pacific Coast Rubber Co.	133, 167.
Paraffine Paint Co.	128.
Pacific Tool & Supply Co.	4.
Reynolds Third Rail Co., Inc.	81, 82, 83, 84, 85, 86, 87, 88, 89, 90, 91, 92.
Selby Smelting & Lead Works	2.
Simonds Machinery Co.	124, 177.
Squires & Byrne Co.	190.
Staples & Pfeiffer Co.	112, 133.
Sterling Rubber Co.	23, 24, 26.
Superior Cereal Food Co.	34.
Tay Co., George H.	28, 29, 30, 31, 32, 33.
Tubbs Cordage Co.	144, 156.
Union Brewing Co.	188.
U. S. Flexible Metalic Tubing Co.	266.
Wagner Electric Co.	129, 130, 170, 171.
Westinghouse Air Brake Co.	118, 183.
Westinghouse Electric Co.	116, 117.
Whittier & Coburn Co.	122.
White Company (Auto)	3.
Witt, G. E. & Co.	168, 169.
Western Electric Co.	136, 164.
Western Saddlery Co.	98, 99.
Woodbury, Geo. E.	223, 224, 225, 230, 1, 2
Worthington, H. R.	26, 27.

HEATING AND VENTILATION.[1]

BY R. B. GUERNSEY, M. E.

To a great majority of prospective buyers, a blower is a blower, and on account of the inexperience of both the user and dealer, the blower selected is frequently not of the right type to do the work expected of it, and while I cannot hope to give you a detailed classification, in a paper of this nature, I have tried to cover the ground along general lines, and trust that the details most interesting to you will be brought up for discussion at the time of reading, since this is the idea in publishing the paper beforehand.

There are five general types of the centrifugal blower and, as each type has its particular field of work, we will start with a general classification and application.

The first type is known as a volume blower, usually made with a cast iron shell and steel plate wheel. The efficient pressure limit of this type is

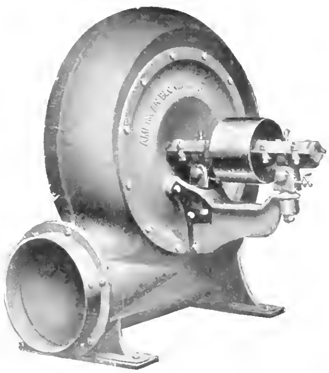


Fig. 1. Volume Blower for Forges or Furnaces Burning Coal or Coke.

4 oz. corresponding to a peripheral velocity of approximately 11,700 ft. per minute. This type should be used for supplying blast for blacksmith forges or furnaces burning coal or coke, and is used for various applications, where volumes of from 200 to 5000 cu. ft. per minute at from $\frac{1}{2}$ to 4 ozs. in pressure are required.

This type is also made as an exhauster, and as such follows the same laws as the blower. The only difference between a blower and an exhauster is that the bearings on a blower are on either side of the shell and air is drawn into the blower from both sides. The exhauster bearings are on one side, the wheel being overhung and air drawn in through one opening. An exhauster can be used as a blower but a blower cannot be used as an exhauster. Used for exhausting fumes, lint from buffing wheels, emery from emery wheels and for drawing shavings from individual machines in woodworking plants, a custom being adopted by a number of the larger mills.

The next type is designed along the same lines, the case and wheel being made of heavy steel plate. This is used principally for exhausting shavings from a series of woodworking machines. Also used in other applications requiring volumes of 1500 to 28,000 cu. ft. air per minute at pressures of from $\frac{1}{2}$ to 4 ozs.

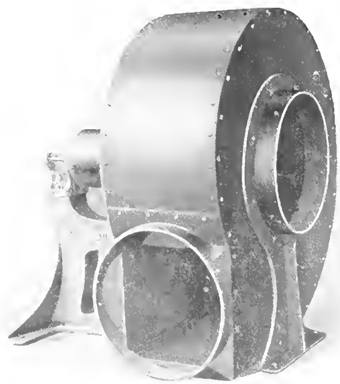


Fig. 2. Volume Blower for Use in Connection with Wood-Working Machinery.

The next type, known as a pressure blower, is practically a continuation of the volume blower and is designed for maximum pressures of 16 ozs. per sq. in. corresponding to a peripheral velocity of about 22,000 ft. per minute.

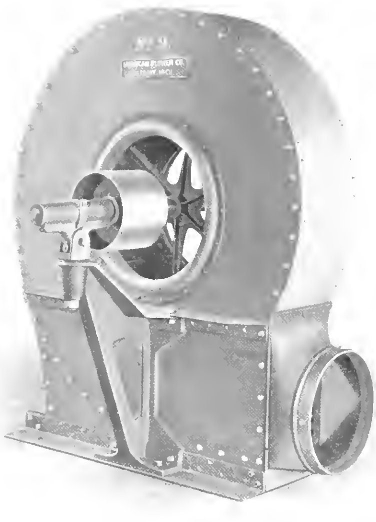


Fig. 3. Volume Blower for Cupola and Oil Furnace Work.

Used largely for cupola and oil furnace work. Some manufacturers make this type with a cast iron shell, although a steel plate shell is far better for the reason that the shell is under a heavy strain owing to the high speeds, and a light external jar will frequently break the shell if made of cast iron.

A type entirely different from either of the above is the disc fan, designed for handling large volumes of air at low pressures, $\frac{1}{4}$ oz. or under.

[1] Paper prepared for N. A. S. E. Convention, San Francisco June 14-19, 1909

This type is used for ventilating, removing fumes or dust from rooms and for various installations where

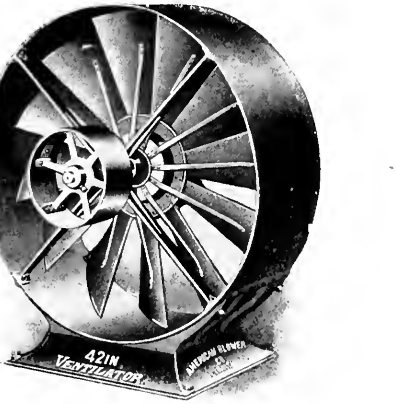


Fig. 4. Disc Fan for Handling Large Volumes of Air at Low Pressures.

the air to be handled is carried but a short distance and at low velocities.

The next type, with which you are probably more familiar, is known as the steel plate fan.

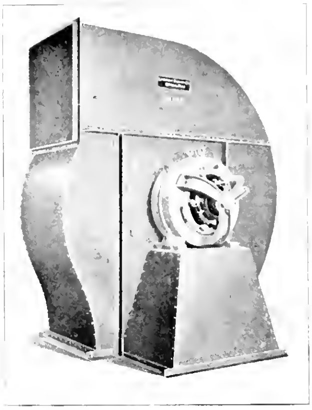


Fig. 5. Steel Plate Fan for the Ventilation of Buildings, Mines, Etc.

This is virtually a large size volume blower, since the maximum economical pressure is 4 oz. per sq. in., and the capacity is almost unlimited. This is the type generally used for the ventilation of buildings, mines, etc. To present these types in a comparative form we have:

Volumes under [illegible] oz.	Disc fan
Small volumes [illegible] 4	Volume blowers or exhausters
Small volumes 4 [illegible]	Pressure blowers or exhausters
Large volumes [illegible] to 4	Steel plate exhausters
[illegible] 4	Steel plate fans

Inasmuch as the term "pressure" is rather misleading, it might be well for us to arrive at a general understanding of this term. The same two forces are at work in the discharge from a fan, as are at present in all mechanical problems, namely, "dynamic" and "static" forces, which we designate as "dynamic pressure" and "static pressure." One is always working against the other, with the result of practically producing a third pressure which we call "air velocity pressure," and which is represented by the difference of the first two pressures.

The pressure and movement of the air is due entirely to the centrifugal force produced by the air sliding off from the fan blades, and the centrifugal force is in direct ratio to the square of the revolutions. With a fan wheel of given proportions the centrifugal force holds a direct ratio to the peripheral velocity.

It is quite evident that when the term "pressure" is used as applied to the centrifugal fan that the term implies velocity and that it is a kinetic and not a potential pressure. This is a distinction that is frequently overlooked by engineers and in many cases has resulted in a practical failure of the apparatus.

If you will always remember in dealing with work of this nature, that a cubic foot of air has its greatest velocity at the instant of leaving the fan tips and can not regain this velocity again—always decreasing due to overcoming friction, you will not make the error so frequently made, of decreasing pipe sizes in order to "increase the pressure."

A good rule to follow is to increase the diameter of a delivery or suction pipe ½ in. for each 100 ft. in length over the diameter of the inlet or outlet of the fan, as the case may be.

For example, we want to deliver 1000 cu. ft. of air per minute through a pipe 800 ft. long. For this we would use a fan with a 7-in. outlet. By the above rule a pipe 11 in. in diameter would be the proper size. The reason for this is that a long run of pipe offers considerable resistance to the flow of air, thereby cutting down the capacity of the fan, and as this resistance varies as the square of the velocity, it is evident that by increasing the area of the duct, we decrease the velocity, therefore the resistance, and increase the capacity of the fan.

The capacity of any fan varies directly as the ratio of blast opening or expressed differently as the ratio of resistance, or ratio of opening in the discharge as compared with the total discharge area. As an example, a given fan when running at 200 turns will handle 20,000 cu. ft. of air per minute requiring 5 h. p. under conditions such that the inlet and outlet are unrestricted. We now place 500 ft. of galvanized pipe on the outlet, and made the same size. The fan running at 200 revolutions will deliver at the end of this pipe approximately 15,000 cu. ft., and since for all practical applications the h. p. also varies directly as the capacity, or blast opening, the h. p. required will be

$$\frac{15}{20} \times 5 = 3.75.$$

You can easily see why it would be impossible for manufacturers to publish capacity tables that would be reliable under all conditions. The more conservative manufacturers rate their fans on about 75 per cent blast opening, and issue catalogue tables on this basis, which is a very safe figure, while others persist in rating on the basis of 100 per cent opening. This accounts for the wide discrepancies in the capacity and h. p. for a given size fan as catalogued by different

manufacturers.

In order that you may have some idea of what you are buying, the following data will enable any of you to check up the size of fan that you will require.

We will assume that 20,000 cu. ft. of air per minute are required for ventilation. A pressure of ½ oz. per sq. in. is ample velocity for this class of work, and is sufficient to overcome the friction in a series of ducts under any normal condition. We know by experience that a peripheral velocity of 4120 ft. per minute is inside the noiseless limit and at 75 per cent opening will produce a static pressure of ½ oz.

The blast opening or equivalent area of the fan is given by multiplying the diameter of the wheel by the peripheral width divided by a constant, expressed as $\frac{D \times W}{C}$ = Bl. Area. C being determined from experimental tests and varying with different percentages of openings. In this case it is 2.8 for 75 per cent opening. Blast area multiplied by peripheral velocity must equal the capacity of the fan.

Therefore $\frac{20,000}{4120} = 4.85$ blast area.

We now assume a diameter of wheel in this case 6 feet.

$$4.85 = \frac{6 \times W}{2.8}$$

$$W = \frac{4.85 \times 2.8 \times 12}{6} = 27\tfrac{1}{4}''$$

The wheel would therefore be 6 ft. in diameter, 27¼ in. peripheral width, and would be housed in a No. 120 fan, would run at $\frac{4120}{6 \times 3.1416} = 219$ r. p. m.

and would require $\frac{20,000 \times 5.2 \times .866}{33,000 \times .4} = 6.8$ brake h. p.

We will now take up the application of the fan.

Probably the first problem that confronts the engineer in laying out a heating and ventilating system is what amount of air will be required for complete ventilation. Unfortunately there is not a fixed standard for basing our calculations, although the present day standard seems to be based on the amount of money that the owner will pay for the system, and after this amount is decided upon a system is then designed to approximate these figures.

The writer believes that the old rule of 30 c. f. m. per person, which is universally used as a standard for school ventilation, is a very safe one to use under any normal condition. This will probably have to be increased 20 to 25 per cent for rooms where smoking is permitted, and 20 per cent for hospitals.

Ventilation is a process of dilution of the impure air in a room by the admission of fresh air, and a room is properly ventilated in the opinion of hygienists when the dilution is such that the CO_2 (carbonic acid) in the air does not exceed 6 to 8 parts by volume in 10,000. Air varies from 4 parts CO_2 to 80 parts per 10,000, depending on where it is taken from.

Basing our calculations on the assumption that the average city air contains 4½ cu. ft. CO_2 per 10,000 cu. ft. air, and that the limit allowed in a room is 8 parts, we have—

$$M = 10000\left[\frac{Q \cdot E}{10000} + .6\right]$$

[As per report dated March 16, 1882, of a commission appointed to examine public schools in District of Columbia.]

Then $\frac{Q \times E}{10,000} + .6$ = cu. ft. CO_2 liberated in room in 1 hr.

This value divided by Q and multiplied by 10,000 gives the proportion of CO_2 in 10,000 parts of air in the room, and this should equal M, the standard of purity desired.

$$Q = \frac{6000}{M-E} = \frac{6000}{8-4\tfrac{1}{2}} = 1710 + \text{ cu. ft. per hr.}$$

Q = cu. ft. to be supplied to each person.

E = cu. ft. of CO_2 in each 10,000 cu. ft. admitted.

M = max. amount of CO_2 that each 10,000 cu. ft. can contain.

.6 = cu. ft. CO_2 exhaled per person per hr.

While this appears to be a very flexible rule, I believe it a far better and more certain basis to work on than the common method of assuming a periodical air change, and inasmuch as the maximum seating capacity of any room or building can be easily estimated, the rule can always be used, with the one exception of stores, where people are constantly going in and out.

For this class of building the quantity of air is determined by the air change method—usually four times an hour for low ceiling, two or three times an hour for high, depending on the amount of exposed surface. So much for the quantity of air. The next step is how to convey this air from the fan to the several outlets. Again we have no fixed rule. The simplest method is to figure on a velocity basis, and as the distributing mains of practically all installations consist of ducts, or horizontal runs and flues or vertical risers, we can figure on the following basis:

Main ducts	900 to 1200 f. p. m.
Branch ducts	600 to 1000 "
Flues	400 to 600 "
Register faces	200 to 350 "

While these are not arbitrary values, they will be found to work out very well in practice. It is well to remember, however, that more mistakes have been made by trying to drive the air too fast, than were ever made by having it move too slowly.

The proper size of duct, flue of register face is arrived at by the formula $\frac{\text{a. p. m.}}{V} \times 144$ = free area in square inches.

Hot air registers are usually placed 8 ft. from the floor, vent registers at the floor line. In rooms where

smoking is permitted, a vent face should be placed near the ceiling in addition to the floor face. This allows the smoke to be taken out without drawing it back to the floor line.

A simple arrangement is to have both vent dampers operated by one cord and as one is closed the other is opened. The average register face has about 1/3 of the inside area obstructed and it is therefore good practice to add 50 per cent to the free area to determine the total area required in the register.

Vent registers, flues and ducts should have the same area as the heat flues and registers, and if a single fan system is installed they had better be designed 10 per cen. greater.

This is on the same principle as filling a barrel with water. This barrel has a 2-inch pipe under 10 pounds pressure supplying it with water, which can flow freely through a 2-inch bung hole. One would perhaps think that the water would flow out as fast as it flows in—nevertheless you can fill the barrel to overflowing. If the vent flues are amply large the results obtained in reducing the percentage of carbon dioxide (CO_2) will be far better and the system will work easier.

Do not attempt to ventilate a building without heating the incoming air. You would not think of blowing cold air into a room and, for the same reasons, do not draw the hot air out, expecting the room to remain comfortable, unless the entering air is warmed. I have noticed buildings heated throughout with direct radiation, with a big exhaust fan installed capable of changing the air three to six times an hour, and the occupants have wondered why they could not keep the rooms warm. Cold air must leak in to replace the air exhausted, and if air is allowed to leak in through a dozen different places, it is impossible to prevent drafts in the room. The plenum or pressure system is the better way to ventilate, and if properly installed there is absolutely no necessity for installing direct radiation in rooms heated by this system. This suggests another much discussed point—single versus double fan system.

The ideal system is necessarily the combined plenum and exhaust system, on account of its flexibility and positive operation. However, if finances will not warrant a layout of this nature, by all means eliminate the exhaust fan, and not the plenum fan. I might add here that a perfect fan system must include some system of temperature regulation. It should be positive in its action and so sensitive in its control that it will hold a given temperature in a room within 1 degree of the required temperature. The principle is based on the relative expansion of different metals—in conjunction with compressed air for power. However, the same rule would apply here as previously given—better have a fan system without this control, than no system at all.

Toilet and kitchen ventilation is of sufficient im[illegible] to consider apart from the general subject. [illegible] of a class of buildings such as [illegible] schools, etc., where the toilets are [illegible] some provision for ventilation. [illegible] a separate fan for this work. [illegible] type of fan and direct connected motor is the best arrangement for one or two rooms and this can be placed in the wall, or a flue can be carried to the roof and the fan located there.

Never blow air into a toilet, as there will be enough leakage into the room, sufficient for ventilation, provided a fan is installed for drawing the air out. In other words, a toilet should be under a vacuum and not a pressure.

Unless a kitchen is very large the same thing applies. The best method of getting smoke and steam out of a kitchen is to construct hoods over the ranges and steam cooking kettles and collecting the gases in these hoods before they become diffused through the room, and when exhaust fans of proper size are connected to these hoods by means of G. I. pipes, a positive removal of these gases is assured. These hoods should not be less than 6½ ft. from the floor on account of tendency to deflect the heat, making it very uncomfortable to work under them.

In very large kitchens so much air is exhausted that it becomes necessary to heat the entering air, on account of cold drafts, and this is accomplished either by a regular heating plant, separate from the main plant, or a branch duct can be carried to the kitchen from the central apparatus. Always be certain, however, that the exhaust system is capable of drawing at least 20 per cent more air out than is blown in, thereby keeping a vacuum in the kitchen and preventing fumes from working through the building.

We can safely establish the rule that kitchens or toilets must always be ventilated by an exhaust fan and preferably individual fans, although this is not absolutely necessary.

Restaurants and smoking rooms should always have a double fan system on account of the smoke. It is always preferable to place exhaust registers as near the ceiling as possible, in order to draw the smoke out before it becomes diffused through the room.

If possible, locate the vent and hot air registers on opposite sides of the room, so that the air is drawn across the room carrying the smoke with it.

I believe the average engineer is not interested in the design of the fan, heater, coils, etc., beyond the point of getting the best in the market at the lowest cost, although he should know the essential features of heating and ventilating apparatus in order to choose the best, and I will endeavor to point out some of these features.

Probably the most important part of an apparatus is the heating coil. Quite a few of you have likely had trouble with heating coils in heating and ventilating system that you have installed and, as there are but two distinctive types of pipe coils on the market, I will try and point out the advantages of one type over the other. To start with, let us consider some of the physical properties of steam.

One lb. of steam under 5 lbs. gauge pressure has a volume of 10.72 cu. ft. and has a temperature of 227°. 1 lb. of water at atmospheric pressure has a volume of .0166 cu. ft. Therefore 1 lb. of steam occupies a space 1200 times greater than 1 lb. of water, under the above average condition in a heating coil. In heating a given quantity of air, by passing over steam coils, from 32° to 106° F. at a velocity across the coils

of 1000 ft. per minute (which would be a fair case for San Francisco climate), 0.6 lbs. of steam would be condensed per lin. ft. per hour. With this rapid rate of condensation, it becomes necessary to build a coil that is absolutely positive in circulation, so that the flow of steam is in one direction without any possible chance of meeting an opposing pressure, which would naturally tend to check this flow.

The American Radiator Company has perfected a cast iron coil known as "Vento Radiation," with which you are probably familiar.

On account of the vento being made entirely of cast iron, it is free from liability of rusting or corroding, and since practically all pipe coil heaters are made of a semi or mild steel pipe, this anti-rust feature is worthy of considerable notice. From the contractors' standpoint it is easier to handle and as a usual rule costs less to install than pipe coils of equivalent heating surface, and its efficiency as a heating agent is about equal to the average pipe coil. Therefore, I believe this type of coil will in time supplant the pipe coil for low pressure work, just as the cast iron radiator has supplanted the pipe radiator.

See that the fan is built of heavy plate well braced to prevent sides from vibrating, that the boxes are self-aligning, ring-oiling type and the wheel is properly balanced.

Allow me to make a suggestion to you bearing on the commercial side of the heating and ventilating installation. Instead of specifying sizes of fans, motors, heating coils, etc., specify the amount of air required per minute, the maximum velocity of fan tips, and the temperature desired.

(As stated before, a peripheral velocity of 4120 feet is always well inside of the noiseless limit.)

Then call for apparatus to be furnished of sufficient capacity to produce these quantities under a guarantee sufficiently exacting to prevent fraud.

This insures you the highest grade product at a minimum cost, for the reason that the better the grade of apparatus the more efficient it is.

The specifying of a certain size fan does not insure you the results desired, for the reason that engineers and architects are dependent on fan manufacturers to a more or less extent for fan performance tables.

The manufacturer of necessity must make these tables on the safe side and, for this reason, a fan sometimes two sizes smaller, if properly designed, will accomplish the desired results.

Manufacturers of fans, as a rule, have spent considerable time and money in developing laws covering their performance, and should be prepared to back up their figures by guarantees sufficiently strong to insure you of proper results, provided the selection of sizes is left to them.

To state the matter more clearly, it is just as possible to design a fan which will handle a given amount of air, requiring a certain h. p., as it is a steam engine to give a certain h. p. output with a given steam pressure, and while it is not generally conceded, the engineering part of this business graduated from the guessing stage long ago. It is true that local conditions affect the fan output considerably more than the engine, but it is possible to determine the actual performance of a fan to within ½ to 1 per cent, before its installation, and this has been accomplished in numerous instances in order to demonstrate the reliability of formulae. However, in handling the matter this way, you must insist on tests being run after installation in order that you may be protected.

There are several methods used for testing the output of a fan, the most common way being the use of an anemometer. In using this instrument, care must be exercised in getting a fair average, and not basing the total output on the velocity recorded in one or two positions on the outlet or register. With a 4-inch wheel anemometer, ½ minute readings should be taken every 6 inches, both vertical and horizontal, and these readings averaged up. This result multiplied by the total free area of the outlet or register will give the cu. ft. of air per minute flowing through the outlet.

For very accurate readings a pitot tube is used, similar to that used in hydraulics; which will give readings in inches of water gauge corresponding to certain velocities.

This method is quite complicated, involves special apparatus and requires considerable time, and therefore is seldom used where approximate results satisfy.

You understand, of course, that a heating and ventilating plant must, of necessity, be designed to suit the building; hence we seldom find conditions twice alike, and you can readily appreciate the impossibility of incorporating in a paper of this nature, any but the broadest of statements. If I have gone into this matter deep enough to rouse your curiosity as to the possibilities of the fan and its application to buildings, I shall feel greatly encouraged.

I believe we have just passed from the luxury into the necessity stage in regard to mechanical ventilation, since it is coming into general use more and more, and I believe the engineer should use every possible argument in favor of it, never losing sight of the fact that a ventilation system is as necessary in a building as a pair of lungs in an animal.

TELEPHONE SERVICE ON SPECIAL TRAIN.

Electrically lighted trains have become so well known to the traveling public as to excite little interest or comment, but trains fully equipped with telephone service between cars, and with a regular exchange, is something entirely new in the way of innovations, especially on the Pacific Coast, where such an equipped train has never been seen. The hundred representative Californians who will go on the California Promotion Committee's visit to the Alaska-Yukon-Pacific Exposition this week will travel on a train the special feature of which will be this telephone service.

The Pacific Telephone and Telegraph Company will provide the equipment, which will require an expenditure of more than $1000, and will have two of its best operators to work the exchange, which will be in operation day and night.

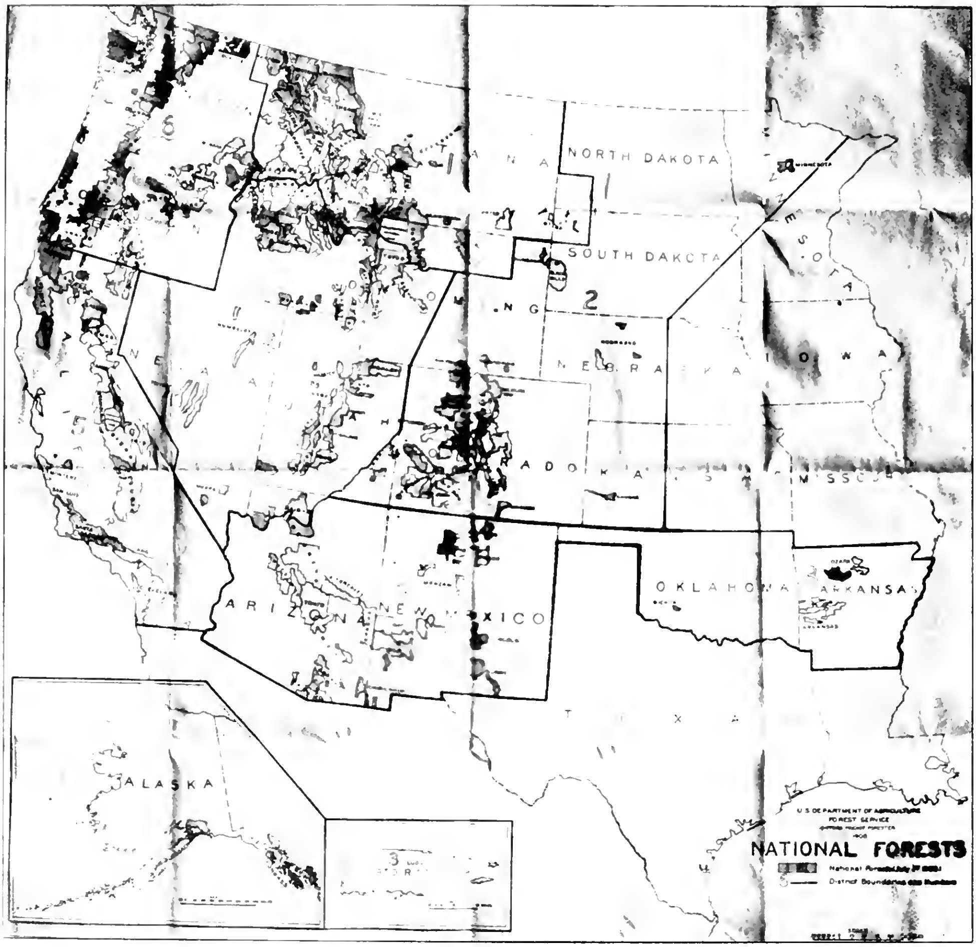
On arrival at Seattle the train will be parked at the exposition grounds, and will be the home of the members of the party while there. Connection will be made with the Seattle central telephone exchange with four or more trunk lines, and the train will be in constant telephonic communication with all parts of that city and with long-distance service.

USING THE TELEPHONE TO FIGHT FOREST FIRES.

BY CHARLES L. MULLIGAN.

The season for forest fires is about to commence. The early summer months with their days of heat and drought invariably bring with them destruction to acres and acres of timber tracts that this country can ill afford to lose. Dr. W. J. McGee, the Government's erosion expert, estimates the aggregate loss from this source, taking in all parts of the country, at no less than a million dollars a day during the dry spell. Last year the fires were worse than ever. Everybody can recall the daily reports of towns wiped out, lives lost [illegible] thousands of square miles of precious woodland [illegible]. It amounted to nothing less than a public [illegible] visitation formed part of the [illegible] Roosevelt's famous message on [illegible] resources. If the fertility of American soil is not to suffer, surely something must be done to guard against another devastation like that of 1908, he argued.

For the loss is not alone to the tracts of wooded land laid waste. The character of an entire countryside is changed by such a conflagration. Many have passed through portions of various States and seen the awful effects of a forest fire—the blackened stumps it leaves behind, the dreary waste of sterile, unproductive land.



Area and Location of National Forests.

Not only is timber burned up, but the loss of foliage has a destructive effect on the atmosphere. The development of streams, upon which the country relies for power, and which forms the distinctive feature of all American landscapes, is arrested. The indirect loss which accrues when forests are burned would be pretty hard to estimate.

Uncle Sam, of course, knows this, and it is interesting to see what has already been done to prevent further loss. The Government exercises sway only

over the national forests, principally in the far west. Here prodigious steps are being taken to safeguard the timber lands from destruction. Principal among the preventive measures is the use of the telephone. Already this common little instrument has succeeded in arresting the progress of several serious blazes, and the experts of the Department of Agriculture are eagerly watching for more proofs of its efficiency.

In the national forests in 1908 lands extending 414,638 acres were burned over. The timber destroyed aggregated 232,191,000 board feet. There is food for thought in these figures. As much lumber as was utterly destroyed last year would build many a good sized town. Cut into planks of the accepted dimension, one inch thick and one foot wide, and laid end to end, it would extend almost twice around the earth. And this, too, in the national forests alone—only the thousands of individual lumbermen whose private interests suffered could furnish any information that would involve a real total.

The Forest Service atlas figures that in the year 1906-7 for every thousand acres of national woodland, .92 acres were destroyed by fire. In the preceding year 1,078 acres per 1000 were burned over. But in the past year, with a report of 414,638 acres destroyed out of a total of 150,831,665 acres of government forest land, including alienations, it can be computed that 2.74 acres out of every thousand were wiped out.

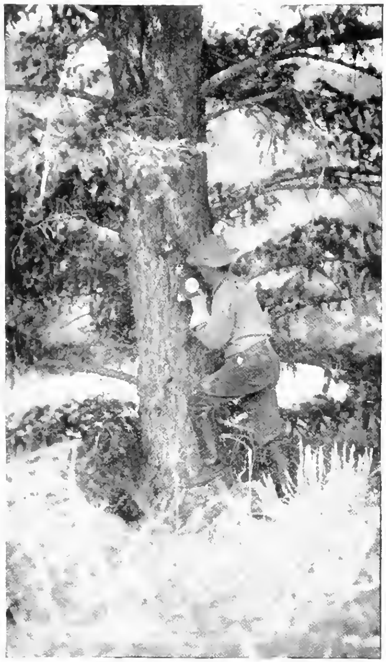
Fires in the forests have their origin in many causes. In the summer months dry leaves and brittle stumps are prolific sources of trouble. The least spark thrown into a pile of woodland rubbish may start a tiny flame—the blaze, invisible for days, perhaps, will smoulder until suddenly it breaks out and seizes tree after tree.

It is possible to avoid one species of risk, and here New York has set a notable example. The Public Service Commission for the second district of the Empire State has directed an important ruling at the railroads. The second district includes all of the State without the boundaries of the city of New York and there are no woods in Gotham, unless one considers the park trees. The New York State railroads last year were found to be the cause of 83 serious blazes, most of them in the Adirondacks. Sparks from locomotives did the damage. Accordingly the Hughes commission, after an inquiry into the facts, has ordered that oil be burned as fuel in locomotives on all roads traversing the wooded lands between April 15th and November 1st of each year.

The foresters wish it were as easy to regulate hunters, who cause more trouble than railroads. New York reports that last year 103 fires of large dimensions were caused by the carelessness of amateur sportsmen. Fifty thousand acres of trees were burned down. The hunter who builds his camp-fire in a clearing and goes away without stamping out the remains; the man who knocks the hot ashes out of his pipe by hitting it against a tree-trunk, and the one who throws his cigar-end off into the bushes at his side little realize what follows in their wake. Probably, if told they were the cause of the great conflagration they see a few days later, they would be astonished.

Quite a few of these fires are started by incendiaries. The fiend who sets the torch to a forest differs very little from his brother, who explodes a bomb in a tenement. Thoughtless children are known to have been the cause of some fires. Still a larger number go unexplained. What to do to check the spread of the flames is a more pressing problem to the government than how they started.

In the national forests are about 200,000 men ready to turn out and fight the flames whenever necessary. This includes regulars and volunteers of all descriptions. During the forest fire season the United States Forest Service employs 1351 rangers and guards. Each man has a certain beat to patrol. Taking into consideration the area of the national forests, it can be calculated that each of these "patrolmen" covers 121,-506 square miles. Quite a long beat for a man, even on horseback.



Using Portable Forest Telephone.

This is where the telephone comes in. Portable telephones are made expressly for this purpose, and with their aid each ranger is kept in touch with his entire area. Let a fire start, and immediately the wires ring with the message of warning. Strapped to the back of the ranger, the telephone is an ever-present and quicker-than-lightning messenger. It has worked wonders lately, and it means almost the only encouragement for those engaged in the apparently hopeless task of combating the forest fires.

In one case last year a government officer summoned help from 43 miles away with his portable instrument. Aid was received more than a day sooner than if a messenger had been dispatched.

Forester Gifford Pinchot's latest report on this subject is dated June 30, 1908. During the year previous to that day 3500 miles of telephone lines were

constructed in the national forests. This year's report will show interesting data. The work has been progressing as rapidly as appropriations would permit, and the number of telephones has been greatly increased. Already this year 2523¾ miles of telephone lines have been constructed.

Portable Telephone Set.

Government telephone lines have been built in Arizona, California, Montana, Nebraska, New Mexico, Oklahoma, Oregon, Utah, Washington and Wyoming. The need of phones has not been underestimated in the past and many miles of telephone line have been constructed in the national forests. The headquarters of many of the forest officers are in isolated parts of the country and in some cases it takes three weeks for an answer to be received to a letter, although the distance may not exceed 60 to 70 miles.

To talk of eliminating forest fires is nonsense, everybody knows that. But if the success to which they may be fought shows a greater percentage through the use of the telephone the Forest Service will feel justified in the expenditure it has made. With the season coming on fast, the men in the woods will find their phones more than useful.

One of these portable telephones is an interesting instrument. The case is handsomely finished in birch or mahogany and is provided with a strap to facilitate handling. It contains a buzzer, hand generator, switch, receiver cord, one dry battery, induction coil, a transmitter and a receiver.

The transmitter is fastened inside the case and the receiver and the other projecting parts are mounted so that they are not likely to be caught by branches. The compactness of the set makes it easy to handle.

OBJECTS OF NATIONAL IRRIGATION CONGRESS.

The primary objects of the Congress are to save the forests, store the floods, reclaim the deserts and make homes on the land. It is purposed to demonstrate to the West the possibilities of this development and to show to the East and South the importance and value of this work to the entire country.

The economic value of irrigation whether by Government project or private enterprise, cannot be measured in dollars and cents. It is a confirmed success from financial and commercial viewpoints, and economists declare that the development of the Western country will provide a safety valve against the impending dangers of congestion in the cities of the East.

WIRELESS TELEGRAPHY ON BOARD SHIP.

BY MAURICE CHILDS.

Even in these days of new discoveries the invention and application of wireless telegraphy stands in the front rank as one of the greatest achievements of modern science. Improvements have followed one another in rapid succession, and indeed wireless electrical transmission has become the fashionable theme of the inventor and scientist. The great progress of Hertzian wave telegraphy has been due almost entirely to the immense service it has rendered to shipping generally; the merchant is no longer cut off from the outside world during voyages from continent to continent; not only is he in constant communication with his business on shore, but he is able to enjoy the luxury of his daily newspaper.

The value of radio-telegraphy to the shipowner cannot be overestimated; the position of a ship fitted with the modern telegraph can be accurately followed and her time of arrival fixed with far more certainty than before its adoption. Passengers now travel with a greater sense of security, knowing that if accidents should happen the flashing of the distress signal, viz: "SOS," would bring ships from all points of the compass rushing to the aid of the disabled boat. The recent event where the lives of the passengers and crew of the S.S. Republic were saved by wireless telegraphy from almost certain death, is still fresh in the minds of everyone; this is, however, but one of the many incidents in which help has been obtained through this medium, and it is safe to say that ere long the fog at sea, which is so disastrous to shipping, will lose many of its terrors when mariners by the aid of wireless will be able to locate the exact position of their own and that of other vessels in the immediate vicinity. The time may also not be far distant when the inefficient methods of signaling by means of flags will be superseded by the more practical and infinitely superior method of wireless telegraphy.

With quite a small installation a range of fifty miles is easily obtained. At the present time there are several more or less known systems suitable for ships, which have been thoroughly tested and proved reliable.

It may be of interest before going further to recount a few of the early experiments which were carried out by Mr. Marconi and others. Prior to the year 1896, when Mr. Marconi first brought his historical "secret box" to this country, Sir William Preece, F. R. S., had been engaged in some very interesting and successful experiments in wireless telegraphy between Rathlin Island and the mainland. The distance covered was approximately two and a half miles, and for a considerable time the apparatus was used by the military authorities.

The system had, however, serious limitations, which can easily be comprehended when it is understood that in order to signal over a given distance it was found necessary to stretch two telegraph lines parallel and opposite one another, each wire being equal in length to the distance between the stations. On the advent of Mr. Marconi in England further experiments in the above system practically ceased. Sir William Preece quickly perceived the enormous advantages of the former's apparatus and its modus

operandi, and at once interested himself in its further development.

In the light of present-day knowledge one is apt to forget the work of the pioneers, but it is a generally recognized fact that but for the kindly assistance of Preece, not only personally, but also officially, Marconi's system would not have held the position it does to-day, either technically or commercially.

The most important of Marconi's early experiments were those carried out between Bournemouth and the Needles, a distance of ten miles. These took place in the year 1898, and it is interesting to note that in these tests the signalling speed was something between three and four words per minute. Subsequently these stations were removed to Poole and St. Catherine's Point respectively.

In 1899 Marconi established wireless communication across the Channel, between the South Foreland Lighthouse and Wimereux, near Boulogne, and at this time public excitement about the new method of telegraphy was at its zenith.

On Dec. 12, 1901, Marconi received signals across the Atlantic at St. John's, Newfoundland, from a large station at Poldhu, in Cornwall. This station was principally designed, so far as the plant was concerned, by Dr. J. A. Fleming, M. A., F.R.S., whose contributions to electrical science are well known.

It would not be fair in passing to omit mention of the experiments carried out in 1903 by Dr. Lee de Forest between Holyhead and Howth Point, in Ireland. Although the distance covered was comparatively short, considerable significance can be attached to these tests, since they demonstrated a very important fact, viz. the possibility of two wireless stations of approximately equal power operating simultaneously without in any degree interfering with one another since within two or three miles of the Holyhead station a Marconi installation was also exchanging messages with Atlantic liners carrying wireless installations.

Mention should also be made of more recent work, but as space is limited, the writer will content himself by giving results obtained during 1908 by the Amalgamated Radio Telegraph Company at their radio station at Cullercoats, near Newcastle.

By means of their latest and most perfected type of recorder, signals have been received at the above station from Lyngby, in Denmark, and printed at the rate of 100 words per minute.

In referring to the early work, the object has been to show how this system of communication has been improved from a technical point of view, and it is now to be shown what enormous advantages are to be gained from equipping vessels with this means of signalling.

Unfortunately, through the desire of interested parties to advertise particular systems of radio-telegraphy, the public have from time to time been apprised, through the medium of the daily press, of extraordinary feats, or better freaks, of communication which may have occurred from time to time but cannot be repeated, and is thus led into believing that vast improvements and developments are going to be made—beliefs which unfortunately have rarely, if ever, been realized by actual results.

This method of disguised advertisement has done much harm to this particular branch of science, since the investing public quickly tire—and rightly so—of hearing promises which have so persistently been unfulfilled, and the capitalist at the present time consequently regards with great skepticism any new and genuine system or improvement which may be brought out by some workers or inventors of unknown public repute, but who nevertheless possess great scientific attainments.

Nothing succeeds like success is the old adage; but how is success to be attained unless facilities are granted by those who can afford them? A very practical instance of the very apathetic attitude of certain classes of English shipowners is afforded by the following: About three years ago it was the writer's privilege to present a scheme to two or three companies owning large fleets of fishing vessels, for equipping some of their vessels with installations of wireless telegraphy apparatus. Among one of the advantages placed before them was the not inconsiderable one of adjusting the arrival of the fleet in port when the market prices were high. To be brief, nothing came of the scheme, but it is interesting to note that our neighbors the Germans have recently adopted practically the same idea, and a number of their North Sea fishing vessels are fitted with installations which appear to give every satisfaction, and answer the purpose for which they were required.

In order to give the reader better information regarding the actual possibilities of radio-telegraphy, a few facts concerning the apparatus employed and its capabilities may be of interest.

To commence with, the distance over which signals can be transmitted and received depends on several factors. The most important of these is the power used in the transmitter. The greater the power, the greater the distance. The distance, however, does not increase in direct ratio to the power employed.

Modern vessels of even quite small tonnage have electric light installations on board, and where this is the case, the telegraphic power may be obtained directly from this source. The normal power allowed for vessels under the regulations laid down in the International Convention of Radio-telegraphy, is one kilowatt or roughly 1 1-3 h. p. This power is sufficient to cover under all circumstances, with one exception, a distance of 200 miles. At times, this distance would be far exceeded, but we are not dealing with possibilities but actual facts. For distances less than the above, say 100 miles, ½ h. p. is ample, and normally considerably less than this can be employed. These figures are, of course, applicable only to communications over sea and not over land.

Other factors which determine the signalling distance are—atmospheric conditions, daylight effects, and the receiving appliances employed. Regarding atmospheric conditions the distance is immensely increased when a fog or sea mist is present—a fact, it should be noted, of a most advantageous character. Wind and rain make little or no difference to the transmission, although the latter may sometimes reduce the range owing to want of care on the part of the operator using the apparatus in the supervision of the plant and maintaining the proper degree of insulation of the radiating wire, or antenna, as it is

technically named. The influence of strong sunlight is to reduce the signalling distance, but this is to some extent nullified by the increase due to darkness. The reader should bear in mind, however, that the above figures represent the minimum distances under all these conditions.

Coming now to the apparatus itself, this can be divided into two classes—that used for transmitting and that used for receiving.

In the present state of the art it is not possible to send and receive messages at the same moment.

When the transmitter is in operation the receiver is temporarily disconnected and vice versa.

Transmitters again can be divided into two classes—those which can inter-communicate with all receiving apparatus adjusted to respond easily to them, and those which only affect instruments very delicately adjusted to them.

The former are termed spark transmitters and the latter are transmitters.

For shipwork, the spark apparatus is undoubtedly the superior, both from a technical and practical standpoint, since it is obvious that inter-communication with all other stations is not only desirable but absolutely essential if the safety of the vessel is to be assured.

Hence, since the object of this article is to deal with radio-telegraphy on ships principally, only the spark form of transmitter will be discussed.

This part of the installation is the most complicated; that is, if any of it can be called complicated as compared with the other machinery now in use on modern ships. For small plants a battery of accumulators, consisting of eight to ten cells, charged from the electric light installation, and connected to the sparking instrument, technically called an induction coil, cannot be much improved upon. By the use of accumulators, placed in a part of the ship which would be least likely to sustain damage either by collision or storm, there is always a store of energy available for signalling in the event of the machinery in the engine-room being disabled. The provision of such auxiliary source of energy should be insisted upon by owners contemplating the equipment of their vessels.

For large powers, from ½ h.p. and upwards, a small rotary-converter is employed.

This machine is used in conjunction with a slightly different form of sparking instrument; in fact, the converter generates alternating current and supplies an ordinary high-tension step-up static transformer. This converter may be housed in any convenient corner, either on deck or just below, and is normally driven by current from the lighting installation, or in the case of failure due to accident, by current from accumulators, or in other cases, and if preferred, by a small petrol or oil engine.

There is another method of obtaining high-tension electric energy, which, although up to the present not in practical use, would appear to have advantages over existing methods so far as first cost and simplicity are concerned. It consists of forcing steam at a pressure of from 75 lb. to 100 lb. per square inch through specially constructed nozzles, the vapour subsequently passing through a well-insulated metal tank or box, in which a few metal points are inserted.

Owing to the friction of the particles of water through the nozzles, electricity is generated in considerable quantities and the tank or box becomes powerfully charged. This apparatus has been much improved recently, and the writer has witnessed pressures of 60,000 volts to 100,000 volts so generated and registered by a Kelvin electrostatic voltmeter.

By the use of this apparatus all converters, transformers, etc., can be dispensed with and the energy taken direct to the aerial conductor or other capacity. There is also a further advantage with this form of generator, in that there is absolutely nothing to get out of order and any marine engineer can effect the occasional renewal of the special friction pieces of the nozzles.

To return to the transmitters employed at the present time, the energy from the induction coil or high-tension transformer is led into a condenser. This condenser generally takes the form of a number of Leyden jars arranged in series or parallel according to the different systems. The use of this form of condenser is to be deprecated for two reasons. The first is the rapid deterioration of the metal surfaces owing to the formation of nitric acid when they are in use; and the second is the large amount of space which is occupied. Very compact serviceable oil condensers can be now obtained, and give little or no trouble.

It is the discharge of the condenser which gives rise to the Hertzian waves which are radiated into space from the aerial or antenna. The latter consists of from one to four or more conductors suspended from or between the masts of the vessel; these aerial conductors should be preferably of phosphor-bronze wires on account of its strength and durability.

In order to set up the waves or oscillations which radiate from the antenna, and which, as said, are generated by the condenser discharge, either one or the other of two types of instruments are generally employed. One is called an oscillation transformer and the other a Helix.

The Helix instrument is the more efficient, but the former offers certain advantages, especially when the primary power exceeds half a kilowatt. The Helix has the advantage of simplicity and immunity from breakdown, whilst the transformer is more costly to manufacture, more complicated, and is more liable to cause trouble through breakdown, although it should be mentioned that this latter is an extremely rare occurrence.

A spark gap, preferably enclosed by some well-insulating and non-hydroscopic material, is also an essential.

Two diagrams, Figs. 1 and 2, show the complete transmitter connections of two plants, using apparatus as described.

Diagram Fig. 1 shows the arrangement of apparatus suitable for working up to a minimum distance of 100 miles, whilst Fig. 2 represents a more powerful installation for working up to 200 miles.

It may be of interest to give here a brief explanation of the generation of the oscillations which can operate suitable receivers over such great distances. If the reader will consider the case of a simple pendulum capable of swinging to and fro, or, in othe

words, performing a series of oscillations, and will assume this pendulum to be held some distance from its vertical axis, and then suddenly released, it will be noticed (a) the pendulum oscillates and finally comes to rest, (b) it oscillates at a certain definite rate, (c) that the rate or frequency of oscillation is not affected by the amplitude of each swing. As is well known, the rate of oscillation is determined by the weight of the bob and the length of the pendulum or the distance from the pivot or point of suspension to the center of the weight.

To consider the electrical equivalent. The condenser corresponds to the weight, and the length of

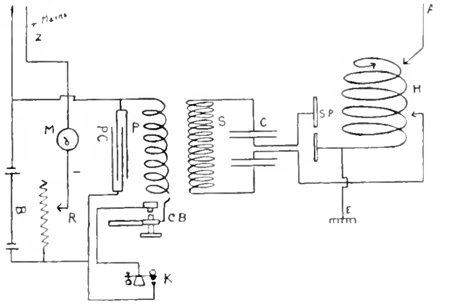


Fig. 1.

the wire between it and the spark gap to the distance. Owing to this gap, the induction coil or transformer is enabled to charge the condenser up to a certain point—determined by the distance separating the two electrodes — when suddenly the strain becomes too great, and a spark is produced. Now, it is at this point that the oscillations are created, since the condenser in discharging does so in the same manner as the pendulum, viz., in an oscillatory manner.

On all vessels other than those of the Navy, the size of the condenser and the length of wire in its circuit must be such that oscillations occur at a frequency of 1,000,000 per second, at which frequency the antenna will radiate a wave of approximately 1000 feet or 300 meters length. This is a standard wave

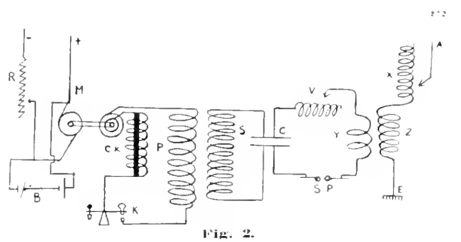


Fig. 2.

length for vessels, and they must be able to produce it. They may in addition be able to obtain any other wave length not exceeding 2000 feet or 600 meters, but the 300-meter standard must be adhered to, except in the cases of small vessels, when special waves may be allowed.

The object of thus standardizing wave-lengths is, primarily to enable all vessels of any nationality and carrying such receiving apparatus capable of being operated by "spark" transmitters to readily intercommunicate.

With regard to the receiving apparatus, there is little to be said. For practical radio-telegraphy, only those types of receivers which employ telephones worn by the operator are of any value. Of these there are several types available, but only two stand out well to the front of others. They are known as the electrolytic and the magnetic types respectively.

The former is by far the more sensitive, and is very reliable in the hands of a careful operator; but the latter is absolutely "fool proof." A good up-to-date installation should include both types of these receivers.

There are several recording receivers also on the market, but, although possessing certain advantages over the telephonic type, they are generally unreliable in their action, more or less complicated to adjust, and expensive; moreover, the speed of signaling with them averages only about 12 words per minute, whereas with the telephonic type speeds of 25 to 30 per minute or even more can be obtained; in fact, with telephonic receivers the speed is limited only according to the ability of the operators.

Radio-telegraphy plays a most important part in the working of His Majesty's Navy. Practically all men-of-war are fitted with apparatus designed in part by Mr. Marconi and by Capt. Jackson, R. N., the latter being one of the early experimenters. Constant communication is maintained throughout the different fleets, orders are given, and maneuvers executed from instructions radiated from the flagship.

The Admiralty building at Whitehall is equipped with a long-distance installation, and from its antenna messages from ships at sea are both sent and received. By this means the progress of maneuvers and latest information is obtained by headquarters. Some of the largest and more recent types of vessels have very powerful installations with a range of several hundred miles.

It is sometimes argued that the comparatively simple manner in which messages can be tapped would be disastrous during time of war, as the enemy would be able to receive signals intended for our own ships. This disadvantage is easily nullified when secret codes are used, and as a matter of fact it would be possible to cause considerable confusion amongst the opposing fleet if information likely to lead them astray were transmitted.

Dealing now with the commercial side, most of the large liners have installations and are open for public correspondence, and telegrams can be dispatched to and from the coast or other vessels.

When a ship station has traffic for shore the operator waits until the coast station required is nearest to the ship; he then signals the call of that place. On the reply being received the boat indicates the number of miles she is from the coast station, her bearing, course, speed, and the number of words to be transmitted; this information is supplied so as to enable the shore, in cases where two or more vessels require to communicate at the same time, to give preference to the boat whose position, etc., shows that she will be the first to pass out of range. After a telegram has been received by the coast station it is

then retransmitted over the landlines to the office of destination.

The rules for acceptance of radio telegrams are somewhat similar to those adopted by the British Postoffice. The cost of the message is made up of the ship station charge, the coast station charge, and the fee for transmission over the landlines. Money-order or reply-paid telegrams are not allowed.

Press messages containing the latest information from the outside world are sent daily from certain shore stations and are read by ships within range, which in their turn retransmit to other vessels in reach of their apparatus; the news received is then printed in the form of a newspaper and sold on board.

The operator requires to be a man with considerable technical knowledge as well as a skilled telegraphist; he cannot take charge of a ship station unless he holds the Postmaster General's certificate, which is granted when an examination in sending, receiving, and practical wireless telegraphy has been passed.

The rules for working were framed at the Berlin Conference of the International Radio Telegraph Convention, for the purpose of arranging regulations, etc., whereby it is possible for ships of all nations to intercommunicate.

Before a ship registered in the United Kingdom can be installed with apparatus a license must first be obtained from the Postmaster-General, and certain restrictions are laid down as to power, wave length, etc. These stations must be opened from time to time to inspection by government officials. Vessels fitted are compelled to interchange telegrams with all coast stations, but are not bound to communicate with other ships except in cases of distress, when such distress signals take priority over all others. Next in importance to these come Admiralty messages. Coast and ship stations are required to suspend all other communication when requested to do so by the naval authorities.

An official list giving all information as to call signal, wave lengths, system used, normal range, hours of service, etc., is published by the International Telegraph Bureau at Berne, and all stations are required to possess a copy.

The Postmaster-General has power to cancel the license of any British ship failing to comply with the regulations laid down, or in the case of a foreign ship to authorize coast stations in the United Kingdom to refuse communication.

Some description of the action and construction of both the electrolytic and magnetic receivers may be of interest. The construction of the former is as follows: A fine glass tube about 2 cm. in length and 1 mm. bore has one of its ends drawn out to a point. Sealed in this point, and securely fastened to a thicker wire inside the tube is a fine platinum wire .02 mm. diameter.

The outside projecting portion of this wire, after the glass has been sealed upon it, is subsequently [illegible]ken off, leaving only the cross-section exposed. [illegible] wire inside the tube is attached to a stout [illegible] slides easily through a brass collar [illegible] a convenient support for holding the point in position.

Other parts of the instrument include a delicate potentiometer, three small dry batteries, a pair of delicate telephones, and a small cup containing a solution of caustic potash or dilute sulphuric acid.

The sensitiveness of the receiver depends to a very great extent on the telephone resistance, which should be as high as possible, generally of the order of 5000 to 6000 ohms the pair.

The point dips into the solution contained in the cup, and is polarized by the dry battery, a film of oxygen gas being produced on the fine platinum wire exposed.

On the arrival of the oscillation energy produced by a spark transmitter, the film of gas is heated and the resistance is reduced; more current therefore can flow through the telephone, and a click or buzz is produced. The connections of this receiver are shown in Fig. 3.

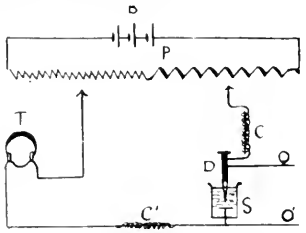


Fig. 3.

The usual form of magnetic detector consists of an endless rope of silk-covered iron wire which passes around two pulleys about four inches in diamter, and kept in continuous motion by clockwork. This rope passes through a small glass tube upon which are wound a few turns in one layer of fine silk-covered copper wire. Over this and on a small bobbin is a second winding of much finer wire, this being connected to the telephones.

Two horseshoe magnets with their like poles adjacent and opposite the secondary bobbin complete the instrument. The action is very simple, being due to the fact that high-frequency oscillations tend to reduce the "hysteria" of iron, consequently, since the magnetic field is normally constant about the secondary winding, any oscillations in the primary cause a change in this state and secondary momentary currents are induced which in turn actuate the telephones.

There is another very practical type of magnetic detector, which has been recently devised and promises to far exceed in sensitiveness the moving rope kind, but as it is not yet commercially launched, the writer prefers to reserve further details for the moment. It can be mentioned, however, that the instrument has proved itself very applicable to wireless telephony.

In practice it is found necessary that all vessels should be provided with a suitable receiving tuning device. Just as it is possible to adjust the transmitter to radiate a wave of predetermined length, so it is possible to make the receiver respond to any given wave, and that wave only, within certain limits.

Of tuning devices there are a great number. They consist essentially of adjustable inductances and condensers, arranged in various ways.

Perhaps the best at the present time is the latest

Marconi device, which is the outcome of many years' study and experience. Fig. 4 shows a magnetic detector coupled to such a tuner, and it may be mentioned that very accurate results can be obtained with it. The advantage of having such a device is obvious, since once communication is established with a station, a rapid adjustment of the tuner brings the signals in much louder; at the same time any other stations in close proximity, working on a wave length differing only by perhaps 100 feet or 200 feet from the transmitting station's wave, can be readily cut out.

Of other similar apparatus, mention can be made of the De Forest three-coil tuner and the variometer.

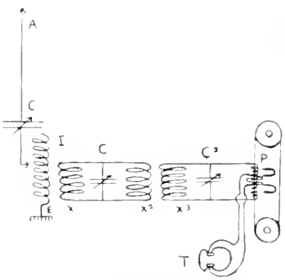


Fig. 4

This latter device is really one of the best types, since all sliding contacts are dispensed with. A simple movement of two superimposed windings in respect to their inductive relation to each other is all that is required to attune the receiver to the transmitter. The correct position is found to the minutest fraction of a degree in a few seconds. Furthermore, cheapness is another important factor in its favor.

There is one other piece of apparatus which it has been made compulsory to have on board, and that is a wave-meter or measurer. These instruments are of various types, but can be made up in a very portable form. As their name suggests, they are used to measure accurately the wave length transmitted and at times received.

Having thus mentioned and described all the principal apparatus necessary for a complete installation for a vessel, it now remains to summarize a few general points both as regards telegraphic working, initial and maintenance costs, etc.

It was stated in an earlier part of this article that certain distances could be covered subject to one exception. That exception is when communication is desired during severe atmospheric disturbances, such as thunderstorms. Just as these storms play havoc with ordinary telegraph and telephone lines, rendering not only the circuits unworkable, but at times dangerous to the operators, so do such storms render radio-telegraphic apparatus useless for the time being. It should, however, be noted that the antenna forms a very efficient protection to other parts of the vessel when lightning is present, provided it is well earthed on the ship's hull, and since it is always arranged so as to be out of reach of passengers, no personal harm from this source has ever been known to occur.

A question the writer has had asked him several times is, "Does the apparatus affect the compasses at all?" The reply is in the negative, provided the transmitting apparatus is placed about 10 feet or 20 feet from the instruments in question.

It is hardly within the scope of this article to deal with such questions as those of costs, since so many factors have to be taken into consideration, but a few approximate figures may be useful as a guide to those unacquainted with this class of apparatus.

A complete installation capable of working over a distance of one hundred miles or more should not exceed £70 to £80, and for a greater distance, say up to 200 miles, from £120 to £130. In addition to this there is the cost of installation, depending on the part of the world in which the vessel is situated. The depreciation on the plant is quite small, the chief item being the outside gear, including the antenna, insulators, ropes, etc., which must be renewed from time to time, say once a year. Five to six pounds should cover everything for the short-distance plant, and from £10-£15 on the other. Next comes the vexed question of the operator. That the apparatus requires to be handled with care and intelligence is undeniable; furthermore the operator must be able to send and receive messages by the Morse code at an average speed of twenty words per minute; but these facts do not necessitate the employment of a special man solely for the purpose of telegraphing. It is quite possible for a member of a crew to be trained in two or three months and obtain the government certificate, and the signaling could be made one of his duties at a comparatively slight increase of salary.

Before concluding this article a few words on the advent of commercial wireless telephony may be given. That this form of communication will eventually solve the qualified operator difficulty is unquestionable, but up to the present no great advancements have been made from a practical point of view. Experienced engineers have been able to hold telephonic communication over distances varying from 50 miles to 300 miles, but unreliability renders the commercial adoption of the system impossible.

That radio-telephony will shortly be within practical politics the writer is confident, since the production of the necessary oscillation energy is being accomplished by means of special dynamos or alternators, which are capable of giving frequencies of 240,000 per second. It is only owing to small mechanical difficulties which present themselves that these generators are not yet on the market, but that these difficulties will be overcome in the near future is unquestionable. Radio-telephony will then be as simple as ordinary telephony is at the present time.

In conclusion, it is hoped that considerable encouragement will be extended by ship owners to this branch of electrical science which can serve them so well and which has already shown itself worthy to be classed among the great discoveries of the nineteenth century.

Electric crop forcing is to be investigated and financed by the recently organized Agricultural Electric Discharge Company of London.

Electric control of guns on battleships, the invention of Rear Admiral Sir Percy Scott, is being tested by the British Navy.

A STUDY OF THE EFFECT OF SULPHUR IN ILLUMINATING GAS ON THE AIR IN ROOMS.

Mr. Arthur D. Little, chemical expert and engineer, Boston, Mass., has recently completed an exhaustive series of experiments to determine the effect of sulphur in illuminating gas upon the air in rooms. In an ordinary dwelling house a single room was set apart for the experiments and apparatus was provided to determine the amount of gas burned within the room, the amount of sulphur originally contained in the gas, the amount of sulphur present in the air of the room, its rate of disappearance and its effect upon objects and human beings. The occasion of these tests was primarily to determine whether a reasonable amount of sulphur in excess of 20 grains per 100 cubic feet, which is the present Massachusetts limit, would prove in any way objectionable. It was shown that under the existing limitations a special hardship was imposed upon the gas producer because of the increasing difficulty of securing coal so low in sulphur as to make possible the manufacture of gas containing not over 20 grains of sulphur to the one hundred cubic feet. Mr. Little has traced out and presented in a very comprehensive report the conditions which originally prompted stringent sulphur limitations. It is his opinion that for the most part these were without justification, and that the liability of danger from sulphur gases has been greatly misunderstood and exaggerated. Also that the removal of sulphur restrictions from gas or an increase in the amount permissible will cause no inconvenience, is attested to by the fact that the gas authorities and examiners of London unanimously report that the removal of restrictions in that city, to such an extent that oxide purification alone is now used, has occasioned no complaints and has proved to be so thoroughly satisfactory that it has since been greatly extended throughout England. It is also a noteworthy fact that the inhabitants of other districts in this country free from sulphur regulations (and but a surprisingly small percentage of the country has any such regulations) do not appear to make any complaints that would indicate inconvenience from sulphur in gas.

The report shows that sulphur gases formed by the combustion of illuminating gas are removed from the air of rooms in three ways: By the changing air in the ordinary course of ventilation, by condensation along with water vapors on the cold walls and windows, and through absorption by the alkaline constituents of the walls and ceilings. It was very clearly demonstrated that other conditions being the same it is only within narrow limits that an increase in the amount of sulphur in the gas or of the rate at which gas is burned causes a relative increase in the sulphur to be found in the atmosphere of the room. When the sulphur present in this atmosphere increases markedly, the more rapid is the reaction between the plaster of the walls and ceilings and the sulphur [illegible]. That is to say, the plaster takes up the sulphur [illegible] still greater rapidity. Calculation, however, [illegible] that the plaster of an ordinary ceiling [illegible] absorb sulphur gases from 20 grains gas burning 25 feet per day during the probable existence of a house. It is therefore evident that in the ordinary dwelling the plaster serves automatically to prevent a material increase of the sulphur in the air, even though there be a great increase in that contained in the gas. The relation of this fact to the hygienic conditions must be manifest. In fact it was shown that the outside atmosphere contained at times one-third to one-fourth as much sulphur as may be found in an ordinary gas lighted room. In a well ventilated room with one or more occupants it was shown that the lighting of the gas would cause such a small rise in the sulphur present as to in no way become manifest to the senses. In fact it was shown that the sulphur would have to be increased many times that of the ordinary room before the senses would be able to detect it.

A careful search through many of the larger works on physiology and physiological chemistry failed to discover any information on the physiological effects of sulphur dioxide. In many of the lists that included carbon dioxide, carbon monoxide, methane and chlorine among the poisonous gases, no mention was made of sulphur dioxide. The sulphur gas commonly mentioned as being poisonous was hydrogen sulphide. The most definite statement found regarding sulphur dioxide simply stated that "sulphur dioxide in large amounts is toxic."

When the concentration of sulphuric acid in the atmosphere rises to about four parts per million in the air it is claimed that the gas can be perceived, not by the smell, but as some describe it, by the taste. At five parts per million, gas can be distinctly smelled. In concentrations above this it produces more or less irritation of the nose and throat, and might therefore have a deleterious effect on the membranes of the air passages.

In none of the experiments conducted by Mr. Little did the sulphur dioxide exceed 0.8 part per million even under the most restricted ventilation, and when gas containing 36 grains of sulphur was used. It becomes evident therefore that in any room where people would live, on account of the carbon dioxide content, the sulphur dioxide from burning gas would never reach a point where it would be harmful.

Even under the most restricted conditions of ventilation it was shown that the burning of gas purified by oxide alone would not give rise to any odors of sulphur gases, and it was evident that any depressing effect was due to the large amount of carbonic acid liberated by the gas. In fact when a great excess of sulphur in the form of dioxide was artificially introduced into the room in addition to that liberated by the burning gas no odor of sulphur gases was noticeable. It was determined as regards the vitiation of the air by carbonic acid that one man had about the same effect as gas burning at the rate of five cubic feet per hour. Even when the ventilation in a room was restricted as much as possible the air changed 1.8 times per hour by diffusion through the plaster and walls. When the ventilation was rendered favorable for regular living conditions, the rate of change of air was several times greater than the figure just given. The influence of such rapid changes of air in a room in augmenting the absorptive effect of the plaster in preventing a high sulphur content is apparent.

The study of humidity conditions made it evident that but little condensation of moistures would

take place on the surfaces of articles in the room, and hence that there would be little or no formation of sulphurous or sulphuric acid, or of injury which might result from the presence of such acids. Metals exposed within the room and also out of doors showed but little difference in the tarnishing effect. No appreciable fading occurred in the case of a large number of dyed samples exposed to the effects of burning gas within the experimental room. The very small amount of sulphur actually discharged into the room by the burning of gas was shown by the fact that the lighting of an ordinary sulphur match would liberate as much sulphur into the room as ordinarily would be liberated by 20 grains burning for 22 minutes.

All of the experiments pointed very clearly to the fact that no injurious effects would result from the burning of gas containing an amount of sulphur materially in excess of 20 grains, and it was finally shown that a raising of the sulphur limitations on gas, while productive of no ill effects, would make available for the gas manufacturer a wider variety of coal and as a consequence, by making unnecessary the wasteful mining methods followed in taking out low sulphur coals, would be an important practical step toward the conservation of one of the greatest of our natural resources.

NATIONAL IRRIGATION CONGRESS.

The National Irrigation Congress will hold its seventeenth session in Spokane, August 9th to 14th. Among the speakers already assigned are James J. Hill, Chairman of the Board of Directors of the Great Northern Railway Company; Howard Elliott, President of the Northern Pacific Railway Company; N. W. Harris, banker, Chicago; F. H. Newell, director of the Reclamation Service; N. W. Halsey, banker, New York; John Barrett, director of the International Bureau of the South American Republics; Dr. George B. Angell of Michigan; Gifford Pinchot, Chief of the Forest Service; Alva Adams, former Governor of Colorado; United States Senator Cummins of Iowa; Governor Gilchrist of Florida; Governor Willson of Kentucky; Governor Paterson of Tennessee, and United States Senator Jones of Washington.

WESTINGHOUSE MOTOR DEALERS' CONVENTION.

On June 14 and 15, 1909, a convention of the Westinghouse motor dealers is to be held at the San Francisco offices of the Westinghouse Electric & Manufacturing Company. The following papers are to be read:

Opening Remarks and General Statement as to Purpose and Intention of this Convention....................
......By Mr. W. W. Briggs, Manager Westinghouse Office

"Motor Applications"..................................
By Mr. E. B. Parsons Westinghouse Electric & Mfg. Co.

"The Selection of Motors for Industrial Purposes"........
By Mr. R. H. Fenkhausen, E. E., Risdon Iron Works, S. F.

"Recent Developments of Westinghouse Apparatus"......
....By Mr. C. E. Heise, Westinghouse Electric & Mfg. Co

"Installation and Operation of Motors and Transformers"
By Mr. Carl Holley, of the firm of Holley & Holley, Visalia, Cal.

"The Co-operation Between Contractors and Central Stations"

"Auxiliary Apparatus Applicable to Motor Installations for Industrial and Power Purposes"....................
By Mr. J. E. Bridges, Detail Engineer Westinghouse Office.

CURRENT COMMENT

Baseball by electric light will soon be tested at the Cincinnati, Ohio, ball park. An Eastern inventor has devised a system of illumination which is to be given a thorough test. Five tall steel towers have been erected and mechanics are now at work installing artificial suns. The inventor claims the park will be flooded with such a strong light that it will be possible to execute any play in baseball that can be pulled off in daylight.

The duty on tungsten is causing the Senate considerable trouble. In a discussion on May 21st, concerning the imposition of a duty of 25 per cent ad valorem on tungsten, inquiry was made concerning the present price of tungsten. Senator Heyburn said that the price was $400 per ton; Senator Burton said that tungsten sold for $900 per ton; Senator Aldrich said he had been informed by men engaged in the tungsten industry that it sold for $1300 per ton, and Senator Nelson quoted from a pamphlet which stated that tungsten ranged in price from $1200 to $1500 per ton. As a result of the discussion the matter of duty on tungsten was put over for future consideration.

Tesla is to signal to Mars, according to a two-column letter to the New York Times. He believes that certain electrical disturbances which he observed in the summer of 1889 must have emanated from Mars, but that all doubt in this regard will soon be dispelled. He criticised unfavorably the various methods that have recently been proposed to convey signals to Mars, and offers one of his own which he states is simple in principle, although perhaps not easy of execution. This consists, first, of a circuit properly designed and arranged, with one of its ends connected to an insulated terminal at some height, and the other to earth. Inductibly linked with this is another circuit in which electrical oscillations of great intensity are set up, the above combination being known as the Tesla wireless transmitter. By a careful attunement of circuits, and by means of certain methods which he has not yet described, oscillations of transcending intensity can be obtained.

The Electrical Contractors' Association of England are to be congratulated on having at last gained the victory in a long-contested struggle. For years they have fought against municipal trading in electric wiring and fitting, and now they have the satisfaction of seeing a clause introduced into the "Electric Lighting Acts Bill" definitely prohibiting this form of unfair competition. During the report stage of this bill, Lord Avebury moved an amendment providing that where the undertakers were a local authority they might "through a contractor, but not otherwise," provide, let for hire, and fix, repair and remove, but should not manufacture, lamps, meters, electric lines, fuses, switches, fittings, lampholders, motors, and other fittings for lighting and motive power. Now that the contractors, by their persistence, have gained for the electrical industry the statutory recognition of their rights as traders and ratepayers, it remains for others to follow up the attack and drive it hard home.

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CONTENTS

Business Efficiency

The efficiency of a small business is usually determined by comparing out-go with income. The business is a paying venture if this ratio be an improper fraction and is a losing one if it be proper. With a large business where this method is impracticable or where the efficiency is near unity it is better to find the losses and add them to the out-go to determine the income. The manifold advantages of the latter method has caused the adoption of a system of corporation book-keeping which will show where the loss as well as the gain takes place. It is essential that a manager know this and his success is often determined by his ability to minimize the loss.

There is probably no industry in which the efficiency of apparatus is more closely determined than in the electrical business where standards have been adopted and the results of physical investigation applied. It may be due to this fact that the electrical business is leading all others in the attainment of uniformity in accounting. Such is true not only in central station, railway, and telephone practice, but also in the manufacturing and selling end.

The first requirement in this arithmetical problem in ratio is to reduce to some common denominator the many factors that enter into it. This denominator depends largely upon the character of the business and the purpose to which the figures are to be applied; in traction work it may be the ton-mile, in central station the watt-hour, and in telephone practice the wire-mile or the station, and in general is some factor involving time, space, weight or wage. These factors are as varied as the forms of business enterprise that they comprise and include much data which may appear extraneous. Adopting the electrical analogy, the efficiency of a business as a whole varies with good or bad times much as that of an electrical system depends upon its load-factor. Internal friction, such as conflicts between employer and employee, have a great bearing on business success. Competition has many points in common with resistance, and freight charges and drayage with transmission and distribution.

Such comparison might be continued indefinitely but it is of merely passing interest. Whereas the greatest efficiency losses usually occur in the motors of an electrical system, so in a business it is upon the efficiency of his subordinates that the manager of a great corporation must rely. No standardization of routine yet devised will eliminate the personal equation. Yet great success is being obtained by setting a standard which gauges a man's efficiency by his record of performance. To the man this acts as an incentive for improvement and to the manager it indicates the unfit, who must obey the usual law of survival.

PERSONAL.

W. A. Purcell has been appointed San Francisco agent for I. P. Frink for the general line of Frink's reflectors.

A. T. De Forest, Pacific Coast manager of the American Steel and Wire Company, San Francisco, is now in the East.

Hugo Reisinger of New York City has received from the Emperor of Germany the commander's cross of the Order of the Crown of Prussia.

E. Ward Wilkins, secretary of the Partrick, Carter & Wilkins Company, Philadelphia, will make his annual Pacific Coast trip some time in July.

H. S. Tittle of the John G. Sutton Company, San Francisco, returned June 7th after a month's trip through British Columbia and the Northwest.

P. H. Reardon of the Compressed Air Machinery Company of San Francisco, left this week for New York City on a trip which will include Pennsylvania and Ohio.

R. B. Daggett of the San Francisco office of the Electric Storage Battery Company is in the East and recently attended the conference of sales managers of his company held at Philadelphia.

H. C. Rice, vice-president and general manager of the General Incandescent Lamp Company, Cleveland, Ohio, will shortly take a trip abroad and is scheduled to sail from New York on June 17th.

An impressive ceremony was conducted off the port of San Francisco on Sunday, May 30th, when the ashes of H. D. Scribner, former local manager of the San Francisco office of the Allis-Chalmers Company, whose death occurred on April 4th, were strewn upon the sea in accordance with a wish expressed by Mr. Scribner some time ago.

J. R. Bibbins, who since 1902 has been associated with the Westinghouse interests at Pittsburg, Pa., recently serving the Westinghouse Machine Company as commercial engineer, after June 18th will become associated in the work of the Public Service Commission of New York as assistant to Mr. B. J. Arnold, consulting engineer and director of appraisals.

OBITUARY.

Irving Loveridge, general superintendent of the European interests of the Western Electric Company, and also manager of the London house of that company, died of pneumonia at Berlin on June 3d after an illness of three weeks.

Mr. Loveridge was a native of New York State and became associated with the Western Electric Company on leaving college. He gradually rose from the ranks to the position of purchasing agent and then assistant manager of the New York house, after which his appointment as manager of the Antwerp business necessitated his locating abroad. He was but recently appointed to the position he occupied at the time of his death.

SALES CONVENTION OF THE ELECTRIC STORAGE BATTERY COMPANY.

The Electric Storage Battery Company held a convention of its sales managers at the Bellevue-Stratford Hotel, Philadelphia, on May 27th, 28th and 29th. An opening address was made by the President and General Manager, Herbert Lloyd, and a paper was read by Charles Blizard, Third Vice-President and Manager of the Sales Department. Papers were also read by J. Lester Woodbridge, Chief Engineer of the company Carroll Hodge, Manager of Construction; Joseph Appleton, Consulting Engineer, and others.

The following managers from the different sales offices were present: New York, Albert Taylor; Boston, Frank J. Stone; Chicago, G. H. Atkin; St. Louis, H. B. Marshall; Cleveland, H. B. Gay; Atlanta, H. H. Seaman; San Francisco, R. B. Daggett; Pennsylvania sales, E. L. Reynolds.

NEW CATALOGUES.

The H. W. Johns-Manville Company is distributing an attractive booklet with the title "Two Sides of the Story." It describes J-M Conduit and includes some illustrated examples of the old and new methods of conduit installation with the resulting saving in dollars by adopting modern methods.

The Electric Appliance Company of San Francisco have in press a revised edition of their well-known loose-leaf price list which has been brought up to date and will be found of the greatest convenience to the buyer of electrical supplies. The new edition of their general catalogue is also about ready for delivery and the catalogue and price list will be distributed to their numerous customers the latter part of this month.

Stanley & Patterson, Inc., New York City, are distributing a pamphlet just issued descriptive of their line of wireless battery material. It covers the line thoroughly, is completely illustrated and treats of the use of this material in connection with motor boat, automobile and general bell work. In addition to this information it includes rules governing pilots on the inland waters and other data of great value to motor boat owners.

Henry D. Sears of Boston, Mass., general sales agent of the specialties manufactured by the Weber Electric Company, has issued Catalog No. 2 describing the sockets, receptacles, rosettes, cut-outs, cleats, knobs, insulators, socket rings, etc., manufactured by the company. This line was placed on the market less than five years ago, and owing to its design, quality, workmanship, appearance, etc., has won a place in the front ranks.

TRADE NOTES.

The Standard Electrical Works have moved from their old location in New Montgomery street to the Roberts Building, 669-671 Mission street, where they are now permanently located.

The Standard Underground Cable Company announces that its general Pacific Coast offices will be located in the First National Bank Building, San Francisco, Cal., on and after June 19, 1909.

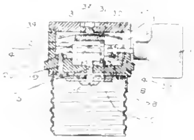
The California Incandescent Lamp Company are now permanently located in their new quarters at 669-671 Mission street, between Third and New Montgomery, with a complete stock of incandescent lamps, Holophane shades and reflectors and other material of this nature.

The Okonite Company, New York city, has recently changed from an English to a United States corporation, and has been organized under the laws of New Jersey. The following named gentlemen are the officers of the company: Willard L. Candee, president; H. Durant Cheever, treasurer; George T. Manson, general superintendent; William H. Hodgins, secretary. The main offices of the company are at 253 Broadway, New York city, and the factories at Passaic, N. J. This company is one of the largest manufacturers of high-grade insulated wire in this country.

The El Paso Street Railway Company of El Paso, Texas, which is controlled by Stone & Webster of Boston, has just closed contracts for the erection of a new power station. The building will measure 39x110 feet and will have steel framework and roof. The original installation will include one 2000-kw. Allis-Chalmers turbo-generator, two 600-kw. B. & W. boilers, equipped with superheaters, Taylor stokers, Alberger barometric condenser of sufficient capacity to take care of the old plant as well as the new, a large motor generator set, pumps, etc. The plant will be equipped for burning coal, and fuel conveyors and bunkers will be installed. The Stone & Webster Engineering Corporation is in charge of the work.

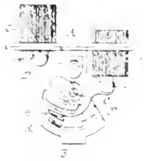
PATENTS

921,839. **Key Socket Switch.** Harvey Hubbell, Bridgeport, Conn. A switch of the character described, comprising a shaft, an angular block loosely carried thereby and carrying a pinion, a spring engaging the angular block, for the purpose



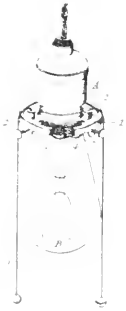
set forth, and a gear wheel meshing with the pinion and carrying a contact plate which rotates in a plane at right angles to the plane of rotation of the shaft.

922,443. **Electric Switch.** Walter Van Patten Steiger, Bridgeport, Conn., assignor to the Perkins Electric Switch Manufacturing Company, Bridgeport, Conn. In a switch of the character described, a pivoted contact member, a spring to actuate the same, and a detent adapted to oppose the



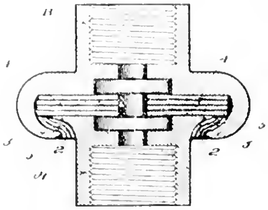
movement of said contact member, in combination with a rock lever provided with means to tension said spring and means to free said detent, said rock lever being pivoted eccentric to said contact member and provided with actuating means adjacent the pivoting point of said rocking lever to obtain a bell crank lever action of the character described.

922,406. **Switching Device for Electric Lamps.** Charles A. Eimer, Los Gatos, Cal. A switch device for electric lamps comprising a socket, a lamp bulb connected thereto, a shade bracket connected to the socket, tubes connected to the



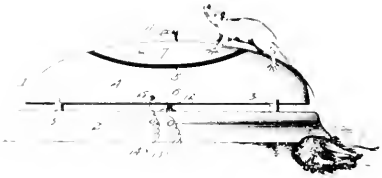
[illegible] attached to the bulb and having an eye [illegible] connected to the eye of the clamp, both ends [illegible] through the tubes and one string being [illegible] to [illegible] the circuit and the other for making the circuit.

922,313. **Insulator.** Louis McCarthy, Boston, Mass., assignor to the Macallen Company, Boston, Mass. An insulator comprising metallic portions separated by laminated insulation and having the crevices and interstices of said laminated insulation free from air and moisture and filled with an



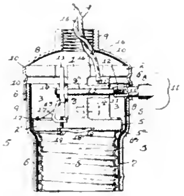
insulating compound consisting of Egyptian asphaltum and animal oil and mineral oil commercially known as ohmlac, said insulating compound being characterized by the quality that it becomes a thin liquid when subjected to a high degree of heat and solidifies at normal atmospheric temperature.

922,377. **Electric Animal Exterminator.** Byron S. Ames, Williamsport, Pa. In an electric animal exterminator, a base, a series of supporting posts arranged on said base, an inner semi-ellipsoidal body portion forming a contact piece or terminal of an electric circuit and supported by said base, a central supporting post or standard arranged in said base, a



flanged head on said standard, an outer contact portion arranged in the upper end of said inner portion and out of contact therewith and forming the other terminal of the electric circuit, and a bait receptacle on the flanged head of said post, and projecting above said outer contact portion.

921,199. **Socket for Incandescent Electric Lamps.** David E. Bown, Pittsburg, Pa. In a lamp socket, the combination of the inner shell, a cap, and a single solid base or block formed of insulating material within said shell and cap having a



partition within the same for forming recesses on each side of the same for the terminals and a projecting portion on the side of said partition for separating the connecting wires leading to the terminals.

INDUSTRIAL

AN INDEPENDENT TELEPHONE PLANT.

BY FRED A. CORNELL

With the expiration of underlying telephone patents, the introduction of competition gave an immense stimulus to the telephone industry. Along with the increasing demand for apparatus, came the organization of many bustling factories. Some of these have lived through the storms of hard times, and one of the largest in business today, is the Dean Electric Company.

The factory of this manufacturer is located on the main line of the Lake Shore & Michigan Southern Railroad in Elyria, Ohio. The property consists of 12 acres of level land with 1200 feet frontage directly on the railroad and 1300 feet on paved city streets. From this factory and by means of ample stocks of standard telephonic equipment maintained at Kansas City and San Francisco, the Dean product is well distributed all over the United States.

Manufacturing Plant of the Dean Electric Company.

The Dean plant includes a main L shaped factory of mill construction to which 140 foot addition has been added, an enameling and condenser shop which also provides space for an Underwriter's fire pump, a complete power and boiler house generating 940 horsepower, a one-story wood warehouse and a new three-story factory addition. In all, there is 120,865 square feet of floor space. The general shop and engineering offices occupy less than 10,000 square feet while all of the balance is utilized in handling or warehousing materials and products, in generating power, in bench and machine room for productive labor and in receiving, carrying and shipping facilities.

FIRE PROTECTION.

More than ample fire protection facilities are furnished by the storage of 100,000 gallons in the pool, and 50,000 gallons in the large tank on the top of the newest factory building, as shown in the illustration. This head of water is connected to a sprinkler system provided by some 2,063 Grinnell glass button automatic sprinklers whose valves fuse open at a heat of 155 degrees Fahrenheit. In other words, there is a sprinkler valve for every 8 feet square under roof, and the enormous tank provides a pressure of approximately 40 pounds of water to the square inch throughout the system. At least 50 pounds of steam pressure, for use in the 750 gallon per minute fire Underwriter's pump, is always available. This outfit is more powerful than the ordinary street engine and the flow can be applied to the sprinkler system or directly through the company's 800 feet of hose to any part of the property. In addition to the company's facilities for fire protection, an 8-inch main is tapped by three fire hydrants immediately adjoining the property and one other hydrant on a six-inch city main.

POWER PLANT.

The company's power facilities indicate the amount of actual productive work being done. Two Stirling type Babcock and Wilcox boilers provide steam for operating two Ball horizontal cross compound engines direct coupled to two Crocker-Wheeler 200 k. w. generators. These generators are easily capable of a 50 per cent overload for a short time. An auxilliary power outfit consists of a Westinghouse gas engine direct coupled to 75 k. w. Westinghouse generator. This smaller equipment is used very economically when only a few departments are running, as any overtime, etc.

There is a total of 940 horsepower available at any time during factory hours.

The boiler room, which is on the left as indicated by the position of the two large smokestacks, has a clear head space

of 30 feet from floor to roof trusses. The engine room on the right has a seven foot cement basement immediately under the engine floor. Through this space, the steam pipes and power leads are carried. There is 25 feet of clear space between the engine floor and the roof trusses. Adequate handling facilities are provided by a five-ton hoisting crane. In this building, adequate space is provided for increasing the present power facilities by 50 per cent without over-crowding either the present boilers or the generator units.

GENERAL OFFICES.

The general offices (windows covered by awnings in the illustration) are located on the first floor of the original factory building. The second floor is occupied by the engineering and drafting forces, while the small tower is utilized as an experimental and testing laboratory. These first and second floor offices are 60 square feet.

THE LATEST ADDITION.

The large new factory structure, in the right background of the illustration, has been completed to meet the constantly growing demands of the manufacturing departments. The entire top floor is utilized for telephone assembling and testing. Telephone parts are assembled on transversely built benches, and these products run smoothly to a long final assembling bench running the entire length of the building, along the third story windows shown in the illustration. Quickly and smoothly each part is placed i. ts proper position, being handled economically by an expert mechanic no matter how small and seemingly unimportant the work may be. In the rear of this floor, careful tests are applied by which the operating efficiency of each instrument is determined to an absolute degree. No single unit that does not come up to the most rigid tests is allowed to be placed on the elevators, dropped into the shipping room on the first floor and transferred to the cars.

The second floor provides ample space for the most convenient location of stock rooms. Carefully numbered and catalogued bins hold the various stocks of raw material and many pieces of material in process. The rapidly enlarging automatic screw machine department, comprising over two score different modern units, is rapidly outgrowing its present limits in the older factory building, and its growth is being looked out for on this second story of the new building.

The first floor provides ample head space for convenient handling of heavier materials. A most interesting piece of equipment is an enormous punch press used in the manufacture of the Dean indestructible steel mouth pieces and receiver shells. The rear of this floor houses the shipping department where cases are closed on the car level, with the delivery doors only the width of a small platform from the cars. In fact, both the receiving and shipping rooms are within a very few feet of the rails upon which the Twentieth Century Limited makes its daily record breaking flights.

GENERAL CONSTRUCTION.

In general, the Dean factory is a modern, sanitary, well lighted and heated factory of substantial, open beam, mill construction. As will be noted from the illustrations, the windows are extremely numerous and of ample size. Although it is possible to construct buildings that require less combustible material, it is highly improbable that any other type of construction would so economically meet the requirements for manufacturing telephone apparatus. The elasticity of semi-steel construction reduces the racking vibration from heavy punch press and machine operations.

SHIPPING FACILITIES.

The location in Elyria provides transportation facilities [illegible] immediately the larger telephone operators in the [illegible] the growing interests in the middle west. Economically maintained branch house stocks, at Kansas City and San Francisco, promptly meet the needs of operators west of the Mississippi, and along the Pacific Coast. Deliveries to the Orient are being made through the San Francisco organization and shipments for Europe and South America are delivered on New York cars without any handling from the factory shipping platform to the loading crane of an ocean going vessel.

APPRECIATING ASSETS.

The Dean tract of land in Elyria provides space for vastly multiplying the present manufacturing facilities and both in manufacturing and residence values the surrounding property is developing rapidly. The city has but lately installed a new fire engine house within two blocks of the Dean plant. Improved streets and ample sewerage also mark the interest of the municipality in the most thriving section of a city that has doubled since 1900. Many Elyria factories were working overtime during 1908, and some industries, notably the Dean Electric Company, met panic-time pay rolls in gold.

WESTINGHOUSE EXHIBIT AT THE NATIONAL ELECTRIC LIGHT CONVENTION.

The large exhibition booth of the Westinghouse Electric & Manufacturing Company at the convention of the National Electric Light Association, Atlantic City, N. J., June 1st to 4th, occupied a central position in Young's Million-Dollar Pier, employing a decoration scheme harmonious with other principal booths, of a pergola covered with grape-vines. The booth illumination was carried out with various sizes and types of Westinghouse tungsten lamps, ranging from 5 to 250 watts. The new 5-watt, 1-candlepower tungsten sign lamps, exhibited for the first time at this convention, mean a great saving in current consumption for electric signs, for an account of the physiological effect of their greater intrinsic brilliancy these lamps are said to be as effective in signs as the duller carbon lamps of several times their candlepower. Series tungsten lamps for street lighting were exhibited, with both the paper cut-out and adjuster socket types of hanger receptacles; 40, 50 and 80-watt metallized-filiment lamps were also shown. The display of arc lamps included a large line of direct and alternating-current apparatus of series and multiple types, mill-type lamps and metallic-flame direct current arc lamps. The Cooper, Hewitt Electric Company exhibited its latest mercury arc lamps in this booth. Westinghouse mercury rectifier sets were shown for storage battery and other small direct current work. Storage batteries and parts were exhibited by the Westinghouse Machine Company. The motor display included a full line of shunt and compound wound direct current, and single, two and three-phase alternating current apparatus. A small motor generator set was used in demonstrating the operation of graphic recording meters, embracing a line of power, current, voltage, frequency and power-factor measuring instruments. Westinghouse portable and switchboard instruments, circuit-breakers, switches and choke-coils were also exhibited. The display of electric conveniences included electric sad irons of various types, introducing the new, rounded, pressed steel toe, tailor's goose irons, new electric toaster stove, hot plates, glue and chocolate warmers, luminous and non-luminous electric radiators, sewing machine and fan motors, etc.

The importance the Westinghouse interests attach to this convention is indicated by the fact that 32 representatives of their different companies were in attendance. These included Mr. W. M. McFarland, acting Vice President, the heads of the principal departments, representatives of all offices including Denver and the East, and the principals connected with the Westinghouse Lamp Company, the Westinghouse Machine Company, the Cooper Hewitt Electric Company, and the Nernst Lamp Company.

NEW TYPE KELLOGG SWITCHBOARD.

The Kellogg Switchboard and Supply Company has made numerous improvements in the express type magneto switchboard which it has had on the market for the past nine years.

Probably the most noteworthy improvement is the new No. 20 drop type combined self-restoring drop and jack. The No. 20 type has all of the advantages of the old No. 3 type, with the additional features of a platinum night alarm contact perfectly protected by the shield below the shutter, and a drop coil which can be removed in a few seconds' time by the aid of a screwdriver and without unsoldering any connections whatsoever. The entire operation of removing the drop coil is carried on from the rear of the board, so that it is not necessary to disturb the operator in any way. This feature will especially recommend itself to telephone companies operating in sections of the country where trouble is experienced from lightning or high-tension circuits. The front view of the switchboard illustrates the accessibility of any line on the board to any operator, and it is only necessary to transfer connections from subscribers appearing in the first two panels to those appearing in the last two, or vice versa. This not only inceases the speed of operation, but decreases the cost of operation. This point will be fully appreciated by operating companies who have been burdened with the type of board requiring the majority of connections to be transferred from one operator to another for completion.

The efficiency of operation has not been the only point considered in this type of switchboard, but special attention has been paid to the maintenance of the equipment. It is a very easy matter to change any drop coil without interfering with adjoining apparatus or in any way mutilating the cable forms. The cord terminals are conveniently located, and all other apparatus, such as condensers, repeating coils, induction coils, and other apparatus, are located on the hard maple panel in the rear of each position. All terminals are lettered and numbered in accordance with the blue print furnished with the switchboard.

All of these numerous advantages, added to the standard quality for which Kellogg apparatus has always been known, makes this magneto equipment unexcelled in efficiency and operation.

In addition to contracts which the Kellogg Switchboard and Supply Company recently made for complete new exchange equipments in Prescott, Arizona, and Mesa, Arizona, they have recently closed contracts for complete harmonic common battery exchanges in Jerome, Arizona, and Bisbee, Arizona.

Express Type Kellogg Magneto Switchboard.

ELECTRIC COOKING AT LOS ANGELES.

The Edison Electric Company of Los Angeles is giving to the people of that city an interesting demonstration of electric cooking in the San Fernando Building. Mrs. A. M. Colby of Boston is the demonstrator, and between 10 a. m. and noon and between 2 p. m. and 4 p. m. daily she shows how easy it is to prepare appetizing dishes by the aid of the appliances in the electric kitchen. A variety of electric cooking utensils and electric appliances of other kinds are shown.

WELSBACH EXHIBIT AT THE GAS EXPOSITION.

The exhibit of the Welsbach Company was one of the very interesting features of the Gas Exposition which was held in Oakland, California, during the two weeks ending May 29th, occupying an attractively decorated booth in which was placed a generous display of "Reflex" and "Junior" lights.

The exposition hall itself was illuminated by "Reflex" Cluster Lamps, "Reflexoliers" and "Humphrey" Inverted Arcs giving to the merchants of Oakland a demonstration of perfect illumination.

Other features of interest were a symphony concert given every afternoon and evening and cooking demonstrations by Mrs. Jean Sinclair and Miss Miriam Choynski.

The entire installation of the exhibit was under the direction of Mr. George V. Hollidge, Chairman of the Novelty Department of the Pacific Coast Gas Association.

Welsbach Exhibit at Oakland Gas Exposition.

Plans are now on foot for an exhibit of the same nature in San Francisco, which will be on a more elaborate scale.

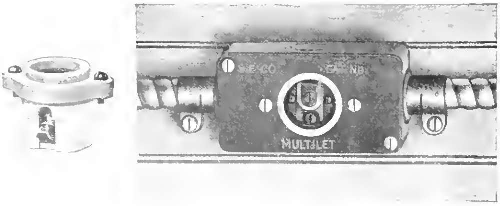
The following dealers made a very complete exhibit of heaters, gas stoves, etc.:

Ingram Hardware Company, "Prize" and "Sweepstakes."
John Breuner Company, "Geo. M. Clarke," "Jewel."
H. R. Basford & H. L. Delaney, the "Rund Automatic Water Heater," "Excelsior" Gas Furnace, "New Method."
R. Dalziel Jr. Company, "New Method."
Pierce Hardware Company, "Garland."
Oakland Furnace Company, the "Hall" Gas Furnace.
Welsbach Company, "Reflex" Lights, "Reflexoliers" and "Reflex" Cluster Lamps.
Busey Furniture Company, "Acorn."
Maxwell Hardware Company, "Ideal."
A. Schleuter & Company, "Cupid."
Jos. Thieben & Company, "Pittsburg Water Heater," "Automatic Estate."
J. J. Martin & Sons, "Douglas," "Eclipse" and "Real," "Economy."
Braley-Grote Furniture Company, "Garland."
Oakland Gas & Electric Appliance Company, "Reliable," "New Process," "Detroit Jewel."

A CONVENIENT RECEPTACLE AND BOX.

The accompanying illustrations show the Sprague Multilet with cover No. 6309 and the G. E. receptacle No. 60,931 which can also be seen in the box.

Unlike many other sign and outlet box receptacles this



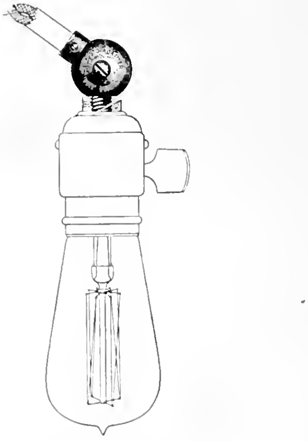
Multilet Box and Receptacle

[illegible] to Sprague multilets for the reason that the screws securing the wire connections to the clips of the receptacle are tightened from the face of the receptacle and not from the back.

This obviates the necessity of having long wires within the box, an advantage which will be quickly appreciated by the wireman.

"TUNGSTO" ADAPTER

The tungsten lamp lasting longest when burned in a pendant position, it is necessary to use some form of adapter when connecting it to the ordinary chandelier socket, which points at an angle of about 45 deg. The Frank Mossberg



"Tungsto" Adapter.

Company, of Attleboro, Mass., manufactures the "Tungsto" adapter illustrated herewith.

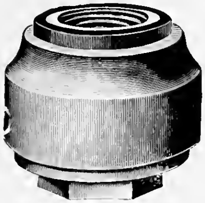
The "Tungsto" adapter is applicable to any style of fixture and is interposed between the socket and the steam as indicated. This adapter is made in various finishes and holds the lamp rigidly in proper position.

S. & P. OIL GAS BURNERS.

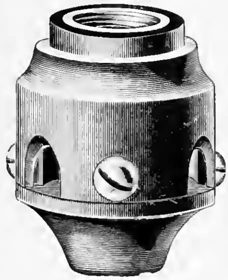
An interesting exhibit at the Mechanics' Fair in San Francisco has been made of S. & P. Oil Gas Burners. Many successful tests have been made of installations of these burners, including tests made at the new U. S. postoffice and court house by U. S. Treasury Inspector G. B. Rice, assisted by chief engineer J. W. Hamilton, on July 31, 1905, under a 150 h. p. Heine water tube boiler, evaporating 15.80 pounds of water per pound of oil. Also the test at the Union Flour Mills, Stockton, by H. G. Balkwill, formerly chief engineer Stockton State Hospital, and A. E. Aubry, chief engineer of the mills, September, 1902, under two 250 h. p. Heine boilers evaporating 15.96 pounds of water per pound of oil in the first test and 16.50 in the second test at the mills. Also the unofficial report of the U. S. S. Cheyenne at Mare Island, making an evaporation of 15.50 pounds of water per pound of oil under four 600 h. p. B. & W. water tube boilers during her high efficiency trials. The Cheyenne is the first warship in the U. S. Navy to successfully burn oil under government conditions. Also the tests made in May, 1902, at the Western Sugar Refinery in a total of 28 different tests using air or steam to atomize, tests made in a gunboat type of boiler of 180 h. p. Tests authorized by the Oceanic Steamship Company under the directions of Ed. T. Morris, superintendent engineer for the company, assisted by J. S. Richards, chief engineer of the steamer Mariposa, and second assistant George W. Clark, the highest evaporation made at the test being 14.26 pounds of water per pound of oil under the positive and definite conditions imposed in the tests of all burners tried.

APPROVED ELECTRICAL DEVICES

DESCRIPTION OF ELECTRICAL FITTINGS APPROVED BY THE UNDERWRITERS' NATIONAL ELECTRICAL ASSOCIATION



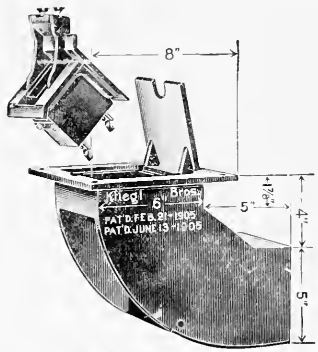
Combination Joint.



Electric Joint.

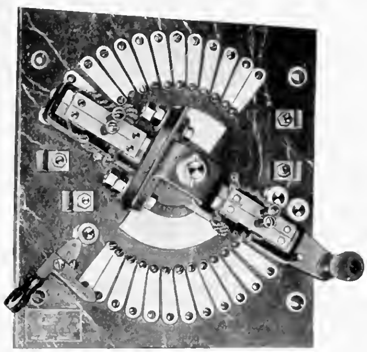
INSULATING JOINTS. "Flagg" combination and straight electric insulating joints. Approved March 17, 1909. Manufactured by **Flagg & Co., Philadelphia, Pa.**

Extra Plug.

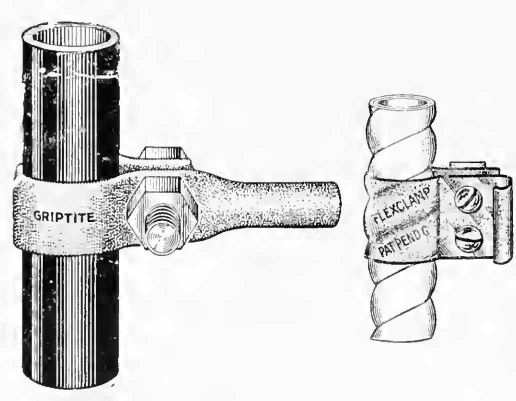


Single Flush Stage Pocket and Plug.

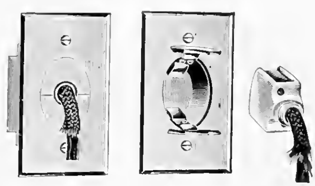
FLUSH STAGE RECEPTACLES. "Kliegl" stage pocket and receptacle, single and gang types. Cat. Nos. 216-219 inclusive, 350, 355, 360, 365, with Cat. No. 301 red fiber or boxwood plug with clamp for removing the strain of the cable from the terminals. 50 a., 125 v. Approved March 17, 1909. Manufactured by **Universal Electric Stage Lighting Co., New York, N. Y.**



RHEOSTATS. Motor starters for squirrel cage type alternating current induction motors described in Manufacturers' Bulletin 18; 5-40 h. p. 110, 220 and 440 to 500 v. Resistance starters for two or three-phase circuits. With pressed steel casings having "hood and pan" at top and bottom. Approved March 16, 1909. Manufactured by **Cutler-Hammer Mfg. Co., Milwaukee, Wis.**



GROUND CLAMPS. "Griptite" clamps for rigid conduit in sizes for ½-inch to 3-inch pipe. "Flex-clamp" for Greenfield flexible steel conduits or armored cable, sizes A-E inclusive. Approved March 9, 1909. Manufactured by **Novelty-Electric Co., Philadelphia, Pa.**



FLUSH RECEPTACLES. "Mesco" Flush Receptacle and Plug, 15 a., 250 v.; Cat. No. 6530. Approved April 7, 1909. Manufactured by **Manhattan Electrical Supply Co., New York.**

CONDUIT, UNLINED. "Enamelduct." Approved March 22, 1909. Manufactured by **C. S. Knowles, Boston, Mass.**

TRANSFORMERS. G. E. transformers for use with arc lamps of moving picture machines. Primary voltages 200, 210 or 220. Secondary amperes 30-40-50 consisting of air cooled transformer mounted upon a slate base and provided with a switch regulating secondary current as indicated. Approved Feb. 13, 1909. Manufactured by **General Electric Co., Schenectady, N. Y.**

WIRES, RUBBER COVERED. Tag on coil to read "Nat'l Elec. Code Standard." Marking, green and black threads parallel in braid; black core. Approved Feb. 6, 1909. Manufactured by **Kerite Insulated Wire & Cable Co., New York.**

NEWS NOTES

TELEPHONE AND TELEGRAPH.

JACKSONVILLE, ORE.—The City Council has granted a franchise to the Citizens' Telephone Company.

MONROE, WASH.—The Independent Telephone Company will probably build a line up the valley in the near future.

BRIDGEPORT, ORE.—A telephone line is to be constructed between Bridgeport and Unity by John Thompson.

DAVENPORT, WASH.—The Farm & City Telephone Company has let a contract for the erection of a building, 26x26, two stories.

THOMPSON FALLS, MONT.—A. S. Ainsworth and associates has formed the Western Montana Telephone Company with a capital stock of $12,500.

MONTAGUE, CAL.—H. M. Bryan and others have been granted permission to erect and maintain a telephone line along the county road from the E. C. Roberts ranch to the town of Fort Jones.

LOS ANGELES, CAL.—The referendum has been invoked by 4,000 citizens, who signed a petition preventing the City Council from making operative a law allowing the Home Telephone Company to increase its rates on residence telephones $1 a month.

TACOMA, WASH.—General Manager William M. Godfrey announces that the general offices of the Home Telephone Company of Puget Sound will be removed from Portland to Tacoma and that $100,000 in improvements in the local system will be made this summer.

ALAMEDA, CAL.—Improvements involving an expenditure of $200,000 are about to be made in the telephone service and equipment in this city. Manager Brownlee of the local office states that all of the overhead wires in the city are to be put into cables, and the wires are to be entirely removed from Park street.

EUREKA, CAL.—County Manager A. E. McLaren of the Pacific Telephone Company received word from Superintendent Jesse B. Mortsolf of the Hoopa Indian Reservation several days ago that the proposed contract between the government and the telephone company for telephonic communication from Hoopa with the Pacific system though a connection at Korbel was expected from Washington shortly.

TELEPHONE CABLES CUT IN PASADENA.

Under date of May 27th, Superior Judge Bordwell of Pasadena, California, handed down a decision declaring it unlawful for the Pacific Telephone and Telegraph Company to erect telephone poles or wires for the transaction of business without a franchise or privilege from the City of Pasadena. The attorneys for the telephone company will carry the case to the higher courts.

Judge Bordwell's decision was in a suit brought by the telephone company against the City of Pasadena to test the validity of an ordinance which became effective in March, 1908. The ordinance was passed for the purpose of forcing the telephone company to apply for a license to erect poles [illegible] s ring wires and provided that without such license all [illegible] and wires are "a public nuisance and any person main- [illegible] thereto shall be guilty of a mis- [illegible] therefor."

[illegible] said

[illegible] is to require the plaintiff to [illegible] streets of the city. The ordinance does not attempt to provide [illegible] means by which it may continue to occupy the streets. It seems to contemplate proceedings for the sale of the franchise to the plaintiffs under the provisions of the Broughton Act, of which the plaintiff may take advantage should he desire."

Judgment was entered for the defendant with costs. A temporary injunction which had been issued was dissolved by the Court.

On the face of it this decision is a serious one to the telegraph and telephone companies who have claimed that they are free from the regulation of cities and have rights under the Federal Government with which local municipalities cannot interfere. Under this decision, the cities have power to regulate all telegraph and telephone companies having lines of poles and operating therein. They can be forced to remove their poles from the cities and to obey all local regulations.

Following the issuance of the injunction by Judge Bordwell on May 27th, several squads of men under guard of the city police in Pasadena started cutting the wires and cables of the Pacific Telephone and Telegraph Company, and according to newspaper reports this work will be continued until the Pacific Telephone and Telegraph Company is completely obliterated from the city. The squads of wire-cutters placed 2700 telephones entirely out of commission in the first few hours' work.

The twenty-year franchise of the Pacific Telephone and Telegraph Company expired in 1907 and since then no franchise has been secured and no allowance paid to the city. The object sought is to force the telephone corporation to take out a new franchise and to pay a semi-annual tax of 75 cents on every pole.

FINANCIAL.

CENTRAL POINT, ORE.—The City Council at its next regular meeting will take the initial step for the issuance of water bonds in the sum of $25,000.

GLENDALE, CAL.—The City Council has passed an ordinance calling a special election to be held on June 22 to vote on the proposition of issuing and selling bonds in the sum of $60,000, for acquiring a municipal electric light plant.

EL CENTRO, CAL.—The Trustees have tentatively accepted the offer of W. F. Holt to sell to the city its domestic water system, lands used for canal and settling basins, and 120 shares of stock in water company No. 1. The board has passed a resolution accepting the offer providing a bond issue is voted and sold for this purpose. An election will soon be called.

OAKLAND, CAL.—No choice for president of the People's Water Company will be made until June 10th, when it is expected that Frank A. Leach will be in Oakland and will give the board of directors an answer to the offer made him of the presidency of the company. On that occasion a definite plan of operation will be decided upon and action taken on proposed improvements.

LOS ANGELES, CAL.—The certificate of creation and increase of the bonded debt of the Lytle Creek Power Company in the sum of $300,000 has been filed with the county clerk. The resolution was adopted by the board of directors and approved by the stockholders at a meeting held April 20th. The loan is for the purpose of retiring all present indebtedness, including the refunding of its present bonded indebtedness incurred on account of the installation of its present plant and system, and to pay all amounts acquired for the purpose of acquiring lands, equipment, machinery, to enlarge water rights, erect buildings, etc. The issue is to

be in the shape of 300 $1000 bonds, to be due and payable on the 1st of March, 1934, and to bear interest at the rate of 5 per cent per annum.

SAN FRANCISCO, CAL.—The merger of the United Railroads and the Stanislaus Electric Power Company, which has been in prospect for several months, has been effected by the filing of articles of incorporation in Redwood City by the Sierra and Francisco Power Company. The capital stock is placed at $20,000,000, of which sum $1000 is subscribed by the following: J. S. Thornton of Sonoma, Winfield Dorn of Oakland, H. J. P. Jackson of Berkeley, George H. Whipple of San Francisco, Warren Gregory of Berkeley. Of these Thornton, Dorn, Whipple and Gregory are connected with the law firm of Chickering & Gregory, which handled the negotiations between the United Railroads people and the original owners of the Stanislaus Electric Power Company. As yet neither the United Railroads of San Francisco nor the United Railroads Investment Company has appeared in the financial records, but these concerns are ready to act. Under the corporate name of the Sierra and San Francisco Power Company the property of the original Stanislaus Electric Power Company and the auxiliary power plants in San Francisco will be merged and given over to the control of a holding company, to be formed in the East under the auspices of the United Railroads Investment Company. The new San Francisco Electric Railway Company which recently took over the Parkside line, will be joined with the Sierra and San Francisco Power Company.

INCORPORATIONS.

SAN FRANCISCO, CAL.—Minoru Oil Company; capital stock $500,000;

FRESNO, CAL.—Alpine Oil Company; capital stock $75,000; by N. Benham, S. N. and L. L. Griffith.

EVERETT, WASH.—Northwest Light and Power Company of Everett; capital stock $100,000; by P. E. Hall Jr. and G. W. Numaw.

FRESNO, CAL.—Awalt Oil Company; capital stock, $200,000; by L. P. Timmins, G. W. Beall, E. Awalt, A. S. Cagwin and F. M. Pool.

SAN FRANCISCO CAL.—Waratah Oil Company; capital stock $300,000; by A. L. Weil, M. Syme, E. B. Davis, Jesse Mueller and W. C. Eckhoff.

MODESTO, CAL.—Turlock Telephone Company; capital stock $50,000; by J. L. Randolph, J. C. Williams, A. J. Eddy, L. J. Gamwell and J. H. Miller.

RED BLUFF, CAL.—Beacon Oil and Gas Company; capital stock of $200,000; by Chas. Hughes, W. A. Fish, J. B. Reese, C. L. Cofer and H. M. Owens.

SAN FRANCISCO, CAL.—Palmer Annex Oil Company; capital stock, $2,000,000; by L. E. Blochman, F. L. Brown, G. I. Walker, L. A. Hilborn and H. W. Barnard.

SPOKANE, WASH.—The Mosso-Berry Electric Company has been incorporated to deal in electric supplies and do a general contracting business at 9 Browne Street.

SAN FRANCISCO, CAL.—Universal Wireless Telephone and Telegraph Company; capital stock $500,000; by J. B. McCarty, M. K. Miller, J. P. McCarty, F. P. Medina and F. P. Herrguth.

SAN FRANCISCO, CAL.—Alaska Commercial Oil Company of Seattle; capital stock $1,000,000; by W. B. Kavanaugh, S. C. John, Ralph Boykar, C. F. Sinclair and Clarence Cunningham.

RENO, NEV.—The articles of incorporation of the Midway and Maricopa Water Company of Fresno, Cal., and Reno, Nev., have been filed in this city. The purpose of the company is to secure water rights and power sites and generate electrical power as well as manufacture gas and heat.

FRESNO, CAL.—Camwell Oil Company; capital stock $500,000; by Wm. H. Crocker, George E. Cameron, Wellington Gregg Jr., Joseph D. Redding, Walter Stopford, W. R. Berry, E. Zimmer; principal place of business, San Francisco.

GOLDFIELD, NEV.—The Hawthorne Bodie Railway Company; capital stock $200,000; directors, Alonzo Tripp, Geo. W. Thatcher and A. M. Nye. The articles provide for the construction and operation of either a single or double track railway by either steam or electric power to the new camp of Lucky Boy, a distance of 16 miles.

ILLUMINATION.

TOMBSTONE, ARIZ.—The City Council has granted to C. L. Cummings a franchise to construct and operate an electric light and power plant.

ST. HELENS, ORE.—The City Council has decided to grant a 25-year electric light franchise to the Cormick Company. The cost of the plant will be about $12,000.

SAN DIEGO, CAL.—The city clerk is receiving sealed bids for furnishing labor and material for installation of ornamental iron posts, conduits and wiring on C street from Third to Sixth.

SAN DIEGO CAL.—The city clerk is receiving bids for furnishing labor and material for installation of ornamental iron posts, conduits and wiring, and for furnishing of electric current, from the south line of B street to north line of C.

HANFORD, CAL.—Manager E. E. Bush of the Hanford Gas & Power Company states that the contract is virtually let to the H. D. Wood Co. of Philadelphia for a new additional gas tank, which will have a capacity of 100,000 cubic feet of gas.

NORTH YAKIMA, WASH.—The Hydro Electric Company has applied to the council for a franchise to use the streets of North Yakima for electric light and power purposes. The company will take water from the Yakima river and convey it through a flume into the Hoxoo valley.

PETALUMA, CAL.—At the Ramona Oil Company's plant in Vallejo township gas has been struck in large quantities. Superintendent McDonald says that the company had gone down 800 feet and had run into sand. The quantity of gas increases with the depth of the well.

GUADALAJARA, MEX.—W. Meridith of San Francisco and W. S. Dole of Portland, Ore., engineers who represent Eastern financial interests, are here to study the local situation in connection with the proposed establishment of a gas plant under the Dominguez-Sessions concession.

LOS ANGELES, CAL.—The litigation between the Hayes and the Lowe factions in the affairs of the People's Gas and Coke Company, ended with the sale at the Broadway side of the courthouse of the entire property to G. H. Hayes, the Goldfield mining man, for $10,000. He was the only bidder and he made but the one bid. The purchaser is one of the largest owners of the bonds of the corporation.

LOS ANGELES, CAL.—A group of local men have organized the Orange County Gas Company with a capital stock of $200,000 for the purpose of engaging in the gas producing and distributing business in Santa Ana and other points in Orange County, Santa Ana to be the location of the principal plant, although head offices will be maintained in Los Angeles. D. L. Peters, M. L. Bellius, John W. Kemp, E. B. Rhoades and John M. Mitchell, all of Los Angeles, are named as incorporators.

TRANSMISSION.

YREKA, CAL.—John Cameron has appropriated 6000 inches of water of Elk creek for power purposes.

HANFORD, WASH.—The Hanford Irrigation & Power Company will extend its transmission line from Coyote Rapids at once.

REDDING, CAL.—By a filing placed on record Tuesday afternoon David Dunn has appropriated 2,000 inches of the water under a 6-inch pressure flowing in Bailey creek for power and irrigating purposes.

SANTA BARBARA, CAL.—The Water Commissioners will receive sealed bids up to June 9th for furnishing 10,000 feet of No. 4-0 (0000) grooved, hard drawn copper trolley wire delivery to be f. o. b. cars or wharf.

EUREKA, CAL.—At the last meeting of the council committee of the whole, Mayor Ricks put before the Council his plans for a power plant on the water front so that water could be pumped from the bay and salt water used in fire fighting.

LOS ANGELES, CAL.—The Board of Public Works will receive sealed bids up to June 18th for furnishing electrical equipment, consisting of one 100 horsepower motor, two 10 horsepower motors, three 5 k. w. transformers, and 3 automatic circuit breakers.

NEVADA CITY, CAL.—Engineer Eurca of the new electric plant on the Middle Yuba, has been in the field for two weeks, surveying for flues, ditches, etc. The power house will be located above the Plumbago plant, and will have an abundance of water for generating purposes, winter and summer. Power lines will be carried to Alleghany.

SALT LAKE CITY, UTAH.—The erection of a heating and power plant sufficiently large to take care of the building of the Temple block and a number of the large buildings in the vicinity, including the Utah Hotel, which is to be erected in the Old Deseret News corner, is the latest project in the direction of economy which is being taken up by Bishop C. W. Nibley and others.

PROSSER, WASH.—Manager Harry Benson of the Prosser Power Company announces plans for a new power plant which will develop all the wasted energy of the Prosser falls and rapids of the Yakima river, and eventually supply light and power for Prosser and the surrounding section and power for irrigation of lands above Sunnyside. A new canal 100 feet wide will be built. Two units of 500 horsepower each will be installed immediately in a stone power house to be erected at once.

REDDING, CAL.—A deed has been recorded here which transfers the C. W. Hamilton ranch and water right to the Northern California Power Company, Consolidated. This is one of the most desirable properties in the Battle Creek country, east of Redding, and consists of 540 acres, with about 850 inches of water running out of Battle, Mill and Brush creeks, which traverse the property. E. V. D Johnson, manager of the interests of the Northern California Power Company, Consolidated, says that an additional unit from which 6000 horsepower will be obtained, should be ready early in July. Mr. Johnson says: "We expect to turn the water into South powerhouse for the generation of current early in July, and will then continue our units, until all are completed, when we will have a combined product of 27,000 horsepower, and this should be available by November 1st of this year. From this point we will go ... to again Battle Creek, where the largest unit of all, 2... horsepower, will be installed. All of these installations will be completed by the end of 1910, making in all in that section available horsepower of 351,000."

TRANSPORTATION.

PHOENIX, NEV.—Dr. Chandler has been granted a street railway franchise on certain public highways in this city.

MONTEREY, CAL.—H. R. O'Bryn has made application to the supervisors for a franchise to construct a street railroad.

LOS ANGELES, CAL.—The Pacific Electric Railway has made an application to the supervisors for an electric railway franchise from E. Seventh street in Long Beach to Redondo avenue, to run 48 years.

SAN FRANCISCO, CAL.—The Central California Traction Company has commenced construction on its line between Lodi and Sacramento. Work has commenced at the Sacramento end and rapid headway is being made with the construction work. With the exception of a small section near Acampo the company has secured all of its rights of way.

OAKLAND, CAL.—The supervisors have granted the Oakland and Antioch Railway Company permission to use a portion of the Alameda County end of the Alameda and Contra Costa County tunnel. The points involved in the transaction hinged upon the authority of the supervisors to grant permission to the company to use the tunnel without the formality of applying for a franchise.

PORTLAND, ORE.—President Josselyn of the Portland Railway, Light & Power Company, gives out the budget for the year as follows: Sheds, foundry and repair shops, $500,000; cutting down bluff for same, unestimated; new plant above Cazedero, $2,500,000; extensions under recent franchise, $2,000,000; carbarns at Sellwood, $65,000; club house, $10,000; electric building, $250,000; steam station, $500,000.

ELLENSBURG, WASH.—The Kittitas County Commissioners have granted a franchise to the Sheelum Roslyn Electric Railway & Power Company, Frank S. Farquhar of Pittsburg, Pa., being the representative of the Eastern stockholders. The franchise stipulates that the road must be completed by December 1, 1911, and that as far as Rosalia it must be completed and in operation by December 1, 1909. The total length of the road will be 17 miles.

STANFORD UNIVERSITY, CAL.—A conference was held here Tuesday between Southern Pacific officials and representatives of the University in regard to the extension of an electric line across the University grounds. At the conference the following Southern Pacific officials were present: Paul Shoup, special representative of E. H. Harriman; Chief Engineer Hood, Division Superintendent Ahern and T. D. Chapin, superintendent of the interurban roads for the railroad. The University was represented by Trustees Timothy Hopkins, Charles G. Lathrop and Judge Leib and Prof. C. D. Marx of the civil engineering department.

SAN JOSE, CAL.—At the last meeting of the City Council City Clerk Walter reported that J. T. Burke had paid into his hands $11,000, the full amount of his bid for the street railroad franchise, which had been petitioned for by the San Jose Traction Company, and an order was made reciting the facts and ratifying the sale of such franchise to him. An ordinance granting such franchise to J. T. Burke was thereupon given first reading and laid over under the rule. It is the same as that which was asked for by the San Jose Traction Company. It is for a term of 50 years, and calls for a broad gauge standard electric road with first class equipment, and has the usual provision for improvement and care of streets between the tracks and for two feet on each side. Work is to be commenced within three months and completed within two years, with a provision for extensions of time for reasonable cause. After five years the holder of the franchise is to pay into the city treasury annually 2 per cent of the gross earnings of the road.

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Kierulff, B. F., Jr. & Co., "Sterling."

INDEX TO ADVERTISEMENTS

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Johns-Manville Co., H. W.

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American Eveready Co., "Ever Ready."

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Sterling Elec. Co., "Bear," "Sequoia."
Standard Electric Works, "Standard."
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Western Electric Co., "Blue Bell," "Liberty."

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Standard Electric Works, "C. & S."
Western Electric Co.

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Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, "Edge Moor."

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Krantz, H., Mfg. Co.

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General Electric Co.
Pass & Seymour.
Paiste Co., H. T., "Shaffer," "K. W.," "P. K.," "Taplets."
Perkins Elec. Swch Mfg Co.
Weber Elec. Co., H. D. Sears, general sales agent.
Westghse Elec. & Mfg. Co.

Transformer Cut-Outs

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour
Westghse Elec. & Mfg. Co.

DYNAMOS

A. C. Dynamos

Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

D. C. Dynamos

Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co
Western Electric Co.
Westghse Elec. & Mfg. Co.

ELECTRIC NOVELTIES

American Ever Ready Co "Ever Ready."

ENGINES

Gas and Gasoline Engines

Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Kierulff, B. F., Jr. & Co., "American Diesel."
Tracy Engineering Co.
Westinghouse Machine Co.

Marine Engines

Standard Engineering Co., "Engberg."

Steam Engines

Moore & Co., Chas. C.
Henshaw, Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Standard Engineering Co.
Tracy Engineering Co., The
Westinghouse Machine Co.

FANS

A. C. Portable Fans
Brooks-Follis Elec. Corp.
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Standard Electric Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

D. C. Portable Fans
Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Sprague Electric Co., "Lundell."
Standard Electrical Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

A. C. Ceiling Fans
Brooks-Follis Elec. Corp.
Standard Elec. Works, "Jandus," "Century."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

D. C. Ceiling Fans
Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
General Electric Co.
Sprague Electric Co., "Lundell."
Standard Elec. Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

Exhaust Fans
Brooks-Follis Elec. Corp.
General Electric Co.
Standard Elec. Wks., "M. A. Co."
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co.

FIXTURES

Ceiling, Bracket and Desk Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.

Marine Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.
Electric Appliance Co.
Sterling Electric Co.

Show Case Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.
Johns-Manville Co., H. W., "Linolite."

Stage Fixtures
Chase-Shawmut Co.,"Shawmut."

FLASHLIGHT (Pocket)

American Eveready Co., "Ever Ready."

FUSE MATERIAL

Enclosed Fuses and Fittings
Bryant Electric Co.
Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co., "Union."
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W., "Noark."
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

Fuse Boxes
Including Service Boxes, Subway Boxes and Junction Cut-Outs for use with enclosed fuses.
D. & W. Fuse Co., "D. & W."
Johns-Manville Co., H. W., "Noark."

Fuse Wire and Links.
Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co.
General Electric Co.
Pierson, Roeding & Co., "Aluminum."

Miscellaneous Fuses
Bryant Electric Co.
General Electric Co.

Paiste, H. T. Co., "H. & L."
Weber Elec. Co., H. D. Sears, Gen'l Sales Agent.

Telephone Fuses
Dean Electric Co.
D. & W. Fuse Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Standard Elec. Works, "Couch & Seeley."
Western Electric Co.

GOVERNORS.

Water-Wheel Governors
Pierson, Roeding & Co., "Lombard."

GUARDS.

Wire Lamp Guards.
Benjamin Electric Mfg. Co. "Can't Break," "Protectalite."
Hubbell, Harvey
Krantz, H., Mfg. Co.

HANGERS

Cable Hangers
Chase-Shawmut Co., "Boston."
Kierulff, B. F. Jr. & Co., "National."
Standard Underground Cable Co., "Nordyke Support."

HEATING MATERIAL.
Including Cooking Utensils, Soldering Irons, Sad Irons, Etc.
Brooks-Follis Elec. Corp.
Elec. Appliance Co. "American."
General Electric Co.
Johns-Manville Co., H. W. "Electrotherm."
Simplex Elec. Heating Co., "Simplex."
Vulcan Elec. Heating Co., "Vulcan."
Westghse Elec. & Mfg. Co.

HOODS.

Street Hoods
Elec. Appliance Co., "Cutter."
Ft. Wayne Elec. Works.
General Electric Co.
Kierulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher."

INSULATORS

Glass Insulators
Brookfield Glass Company, "Brookfield."
Elec. Appliance Co., "Hemingray."
Pierson, Roeding & Co., "Locke Triple Petticoat."
Roebling's Sons Co., John A., "Knowles."
Standard Electrical Works, "Standard."
Western Elec. Co., "Brookfield."

High-Tension Insulators.
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Ohio Brass."
Pass & Seymour.
Pierson, Roeding & Co., "Locke."
Roebling's Sons Co., John A., "Lima."
Thomas & Sons Co., R.
Western Elec. Co., "Thomas."

Porcelain Insulators
General Electric Co.
Johns-Manville Co., H. W.
Pass & Seymour
Pierson, Roeding & Co., "Locke."
Standard Electrical Works, "Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Electric Co., H. D. Sears, gen'l sales agent.
Western Elec. Co., "Thomas."

Wood Knobs
Blake Signal & Mfg. Co.

INSULATING MATERIAL.
Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co., "Di-electric."

Johns-Manville Co., H. W. "Asbestos Wood," "Indurated Fibre," "Vulcabeston," "Monarch," "Phoenix," "Electrobeston."
Paraffine Paint Co., Agents "P. & B." Products.
Standard Underground Cable Co., "Ozite."

LAMPS.

Electric Arc Lamps
Brooks-Follis Elec. Corp.
Elec. Appliance Company, "Adams-Bagnall."
Ft. Wayne Electric Works, "Wood."
General Electric Co.,"G. E."
Standard Electrical Works, "Jandus," "Boulevard."
Western Electric Co.,"Hawthorne."
Westghse Elec. & Mfg. Co.

Flaming Arc Lamps
Brooks-Follis Elec. Corp.
General Electric Co., "G. I."
Western Elec. Co., "Victor."
Westghse Elec. & Mfg. Co.

Incandescent Lamps
Brooks-Follis Elec. Corp., "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co. "California."
Elec. Appliance Co., "Packard."
General Elec. Co., "Edison," "Lowatt."
Johns-Manville Co., H. W., "Linolite."
Kierulff, B. F., Jr. & Co., "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc. Lamp Co., "Sunbeam," "Regal."
Western Electric Co., "Sunbeam," "Regal."
Westghse Elec. & Mfg. Co "Westinghouse."

Miniature Lamps.
American Ever Ready Co "Ever Ready."

Tantalum Lamps
Bryan-Marsh Co., "Imperial."
General Elec. Co., "Meridian," "Tantalum."
Kierulff, B. F., Jr. & Co., "Excelsior."
Sunbeam Inc. Lamp Co., "Sunbeam."
Western Electric Co., "Sunbeam."

Tungsten Lamps
Brooks-Follis Elec. Corp., "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co., "California."
Elec. Appliance Co., "Packard."
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc. Lamp Co., "Sunbeam."
Western Electric Co. "Sunbeam."
Westghse Elec. & Mfg. Co.

LINE MATERIAL.

Street Ry. Line Material
General Electric Co.
Johns-Manville Co., H. W., "J-M."
Kierulff, B. F., Jr. & Co., "Lord Electric Co."
Pierson, Roeding & Co., "Ohio Brass Co."
Western Elec. Co., "Electrose."
Westghse Elec. & Mfg. Co.

MACHINES

Refrigerating Machines
Vulcan Iron Works

MINING

Mining Machinery
General Electric Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C.
Westghse Elec. & Mfg. Co
Western Electric Co.

METERS

Ammeters and Voltmeters

American Ever Ready Co. "Every Ready."
Ft. Wayne Elec. Works, "Wood."
General Electric Co.
Johns-Manville Co., H. W., "Victor Combination."
Western Electric Co.
Westghse Elec. & Mfg. Co.
Weston Elec. Instmt. Co.

Gas Meters

Pacific Meter Co.

Wattmeters

Duncan Elec. Mfg. Co., "Duncan," "Monetary."
Electric Appliance Co., "Sangamo."
Ft. Wayne Electric Works.
General Electric Co.
Johns-Manville Co., H. W.
Weston Elec. Instmt. Co.
Westghse Elec. & Mfg. Co.

MOTORS

A. C. Motors

General Electric Co.
Kierulff, Jr., & Co., B. F., "Ideal."
Standard Electrical Works, "Century."
Telephone & Elec.Equip.Co "Holtzer-Cabot."
Western Electric Co.
Westghse Elec. & Mfg. Co.

D. C. Motors

Elec. Appliance Co., "Colonial."
Ft. Wayne Electric Works.
General Electric Co.
Standard Electrical Works, "Century."
Telephone & Elec.Equip.Co. "Holtzer-Cabot."
Western Electric Co.
Westghse Elec. & Mfg. Co.

MOULDING

American Circular Loom Co., "Lutz."
Johns-Manville Co., H. W., "Electrobestos."

PAINTS.

Insulating Paint

Kierulff, B. F., Jr. & Co., "Di-electric."
Paraffine Paint Co., The, "P & B."
Standard Underground Cable Co., "Ozite."

PINS

Iron Pins

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Hubbard."
Pierson, Roeding & Co., "Locke."
Roebling & Sons Co., J. A., "Lama."
Thomas & Sons Co., The R., "Lee."
Western Electric Co., "Lee." "Fletcher."

Wood Pins

Kierulff, B. F., Jr. & Co.
Pierson, Roeding & Co., Eucalyptus and Locust.

PIPE.

Iron and Steel Pipe.

Shaw-Batcher Co., The

PLUGS.

Attachment Plugs.

Benjamin Elec. Mfg. Co.
Brooks-Follis Elec. Corp.
Bryant Electric Co.
Electric Goods Mfg. Co., "Howes."
General Electric Co.
Hubbell, Harvey
Paiste Co., H. T., "Pushin."
Pass & Seymour.
Stanley & Patterson Inc., "New Code."

Flush Plugs

[illegible] Elec. Corp.
[illegible] Co., "Chip-[illegible]
[illegible] The
[illegible]
[illegible] Harvey
[illegible]
Stanley & Patterson Inc., "Simplex."

Stage Plugs

Chase-Shawmut Co., "Cushing."
General Electric Co.
Stanley & Patterson, Inc., "Fielding."
Standard Electrical Works, "Kleigle."
Western Elec. Co., "Krueger."

POLES.

Iron and Steel Poles.

California Pole & Piling Co.
Kierulff, B. F., Jr. & Co., "Tripartite."
Pierson, Roeding & Co.

Wood Poles

California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Sterling Electric Co.
Western Electric Co.

PUMPS.

Centrifugal Pumps

Goeritz & Co., O. C.

Turbine Pumps

Goeritz & Co., O. C.

PUSH BUTTONS.

American Ever Ready Co. "Nosern."
Brooks-Follis Elec. Corp.
Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.
Pass & Seymour.
Western Electric Co., "Edwards," "Midget, Jr.," "New Mite."

RAIL BONDS.

Chase Shawmut Co., "Shawmut."
General Electric Co.
Johns Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Thomas."
Pierson, Roeding & Co.
Roebling's Sons Co., J. A.
Westghse Elec. & Mfg. Co.

RECTIFIERS.

General Elec. Co., "Mercury Arc."
Westghse. Elec. & Mfg. Co., "Cooper Hewitt."

RHEOSTATS

Field Rheostats

Ft. Wayne Elec. Works.
General Elec. Co.
Simplex Elec. Heating Co.
Standard Electrical Works, "Union."

Motor Starters

Ft. Wayne Elec. Works.
General Elec. Co.
Standard Electrical Works, "Union."
Westghse Elec. & Mfg. Co.

SEARCHLIGHTS

Ft. Wayne Elec. Works
General Elec. Co
Std. Elec. Wks. "Engberg."

SHADES

Benjamin Elec. & Mfg. Co.
Dale Co.
Elec. Appliance Co., "Cutter."
Holophane Co.
Hubbell Harvey.
Pass & Seymour.
Western Electric Co., "Marter."

SOCKETS

Including all classes of Sockets and Receptacles.

American Ever Ready Co "Ever Ready."
Benjamin Elec. and Mfg. Co., "Twin Socket," "Benjamin W. P. Socket.
Bryant Elec. Co. "Bryant."
General Elec. Co., "Edison."
Hubbell, Harvey. "Hubbell Pull Socket."
Johns Manville Co., H. W., Moulded Mica W. P. Sockets
Paiste Co. H. T., "Fielding and Holoshade."
Pass & Seymour.
Perkins Elec. Swch Mfg Co.

Stanley & Patterson, Inc., "New Code" W. P.
Weber Electric Co., H. D. Sears, gen'l sales agent.

SOLDERING MATERIAL

Self-Fluxing Solder

Belden Manufacturing Co.
Dean Electric Co.—"1900."
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "Dielectric."
Western Electric Co.

Soldering Paste

Belden Manufacturing Co.
Blake Signal & Mfg. Co., "Aluminum Tube."
Chase-Shawmut Co., "Red E."
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F., Jr. & Co., "Dielectric."
Standard Electrical Works, "Standard."
Western Elec. Co., "Hawthorne."

Soldering Salts

Belden Manufacturing Co.
Western Elec. Co., "Hawthorne."

Soldering Sticks

Belden Manufacturing Co.
Western Elec. Co., "Hawthorne."

STREET CARS.

Pierson, Roeding & Co., "Brill."

STAPLES

Insulating Staples

Blake Signal & Mfg. Co.
Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co., "Blake."

SWITCHES

Pump Switches

Krantz, H., Mfg. Co

Ceiling Switches

Krantz, H., Mfg. Co.

Door Switches

Edwards & Co., "Eco," "Lungen."
Perkins Elec. Swch Mfg Co.
Standard Electrical Works, "M. & M."
Telephone & Elec.Equip.Co. "H. & H."
Western Elec. Co., "Eco," "Lungen."

Snap Switches

Arrow Elec. Co., "Arrow E."
Cutter Co., The, "C-S."
Dale Co.
General Electric Co.
Krantz Mfg. Co., H.
Perkins Elec. Swch Mfg Co.
Standard Electrical Works, "M. & M."
Telephone & Elec.Equip.Co. "H. & H."

Knife Switches

Chase-Shawmut Co.
General Electric Co.
Krantz Mfg. Co., H.
Paiste Co., H. T.
Perkins Elec. Swch Mfg Co.
Std. Elec. Works, "Barkelew."
Western Electric Co.
Westghse Elec. & Mfg. Co.

Oil Switches

Jacobson, J. C.
Pacific Electric & Manufacturing Co.

Pendant Switches.

General Electric Co.
Pass & Seymour

Perkins Elec. Swch Mfg Co.
Standard Electrical Works, "Jandus."

Pole Top Switches

Jacobson, J. C.
Pacific Electric and Manufacturing Co.

SWITCHBOARDS

Power Boards

Cutter Co., The
Ft. Wayne Elec. Works.
General Electric Co.
Krantz Mfg. Co., H.
Paiste Co., H. T., "Panelettes."
Standard Electrical Works, "Barkelew."
Western Electric Co.
Westghse Elec. & Mfg. Co.

Telephone Boards

Dean Elec. Co.
Elec. Appliance Co., "Eaco."
Elec. Goods Mfg. Co., "Annunciaphone," "Rotokoll."
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Switchboard and Supply Co.
Standard Electrical Works, "Couch & Seeley."
Western Electric Co.

TAPE

Belden Manufacturing Co. "Century."
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "Eaco."
General Elec. Co., "Paragon."
Johns-Manville Co., H. W., "Magnetto," "Fibroid," "Nigrite," "J.-M."
Kierulff, B. F., Jr. & Co., "Imperial."
N. Y. Insulated Wire Co., "Grimshaw," "Competition."
Okonite Co., The, "Okonite," "Manson."
Paraffine Paint Co., The, "P. & B."
Standard Electrical Works, "Standard."
Sterling Elec. Co., "Bear," "Sequoia."
Western Electric Co., "Victor," "Amazon."

TELEPHONE EQUIPMENT

Dean Electric Co.
Electric Appliance Co.
Electric Goods Mfg. Co.
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Standard Electrical Works, "C. & S."
Telephone & Elec.Equip.Co "Stromberg-Carlson."
Western Electric Co.

TOOLS.

Automobile Tools

American Ever Ready Co "Ever Ready."

Construction Tools

Kierulff, B. F., Jr. & Co.
Klein & Sons, Mathias

Wire-Cutting Pliers

Klein & Sons, Mathias

TOWERS (STEEL).

Kierulff, B. F., Jr. & Co., "Tripartite."
Pierson, Roeding & Co.

TRANSFORMERS

American Transformer Co., "American."
Duncan Elec. Mfg. Co.
Elec. Appliance Co., "Packard."
Ft. Wayne Electric Works, "Wood."
General Electric Co.
Western Elec. Co., "American."
Westghse Elec. & Mfg. Co., "Westinghouse."

TURBINES

Steam Turbines

General Elec. Co., "Curtis."
Western Elec.Co.,"Rateau."
Westghse Machine Co., "Westinghouse-Parsons."

Water Turbines

Goeriz & Co., O. C.
Pelton Water Wheel Co., "Pelton-Francis."

TELEGRAPH INSTRUMENTS.

Western Elec. Co.

WIRE

Aluminum Wire.

Pierson, Roeding & Co.

Annun's and Office Wire

Belden Manufacturing Co.
Electric Appliance Co.,"Ansonia."
Phillips Insulated Wire Co.
Roebling's Sons Co., J. A.
Safety Ins. Wire & Cable Co.
Standard Und. Cable Co.
Western Electric Co.

Armored Wire

Sprague Electric Co., "Greenfield."
Standard Und. Cable Co.

Asbestos-Covered Wire.

Belden Manufacturing Co.
D. & W. Fuse Co., "Deltabeston."
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Heany."
Safety Ins. Wire & Cable Co.
Western Elec. Co., "Deltabeston."

Bare Copper Wire

Belden Manufacturing Co.
Roebling's Sons Co., J. A.
Kierulff, Jr., & Co., B. F.
Phillips Insulated Wire Co.
Pierson, Roeding & Co.
Standard Und. Cable Co.
Telephone & Elec.Equip.Co. "American Elec. Works."

Enameled Wire

Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Hawthorne."

Iron Wire

Belden Manufacturing Co.
Roebling's Sons Co., J. A.

Magnet Wire

Belden Manufacturing Co.
D. & W. Fuse Co., "Deltabeston."
Electric Appliance Co., "Ansonia."
Kellogg Switchboard and Supply Co.
Kierulff, Jr., & Co., B. F.
Roebling's Sons Co., J. A.
Standard Und. Cable Co.
Western Electric Co., "Hawthorne."

Rubber-Covered Wire.

Belden Mfg. Co.
Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Indiana Rubber & Insulated Wire Co.,"Paranite."
Kierulff, B. F., Jr. & Co., "National."
Roebling's Sons Co., J. A.
N. Y. Insulated Wire Co., "Grimshaw," "Raven Core."
Okonite Co., The, "Okonite."
Phillips Insulated Wire Co., "Parac."
Safety Ins. Wire & Cable Co.
Simplex Electric Co., "Simplex." "Climax."
Std. Und. Cable Co., "Tip Top," "Marsh." "Sterling."
Western Electric Co., "Habirshaw," "Parac."

Weatherproof Wire.

Elec. Appliance Co., "O.K."
General Elec. Co.
Kierulff, B. F., Jr. & Co., "Chicago."
Okonite Co. The, "Candee."
Phillips Insulated Wire Co., "O. K."
Roebling's Sons Co., J. A.
Simplex Elec. Co., "T. Z. R."
Standard Und. Cable Co.
Telephone & Elec.Equip.Co. "American Elec. Works."
Western Electric Co., "O. K."

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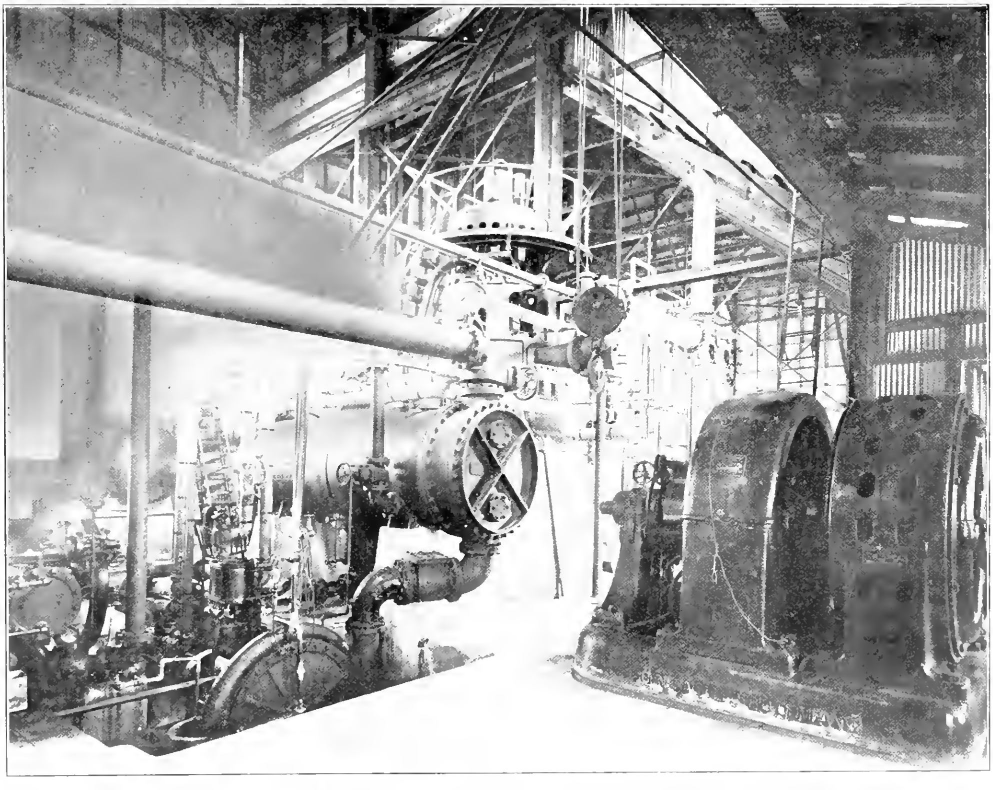
SOME PRACTICAL CONSIDERATIONS CONCERNING THE CHOICE OF PRIME MOVERS.[1]

BY W. B. GUMP.

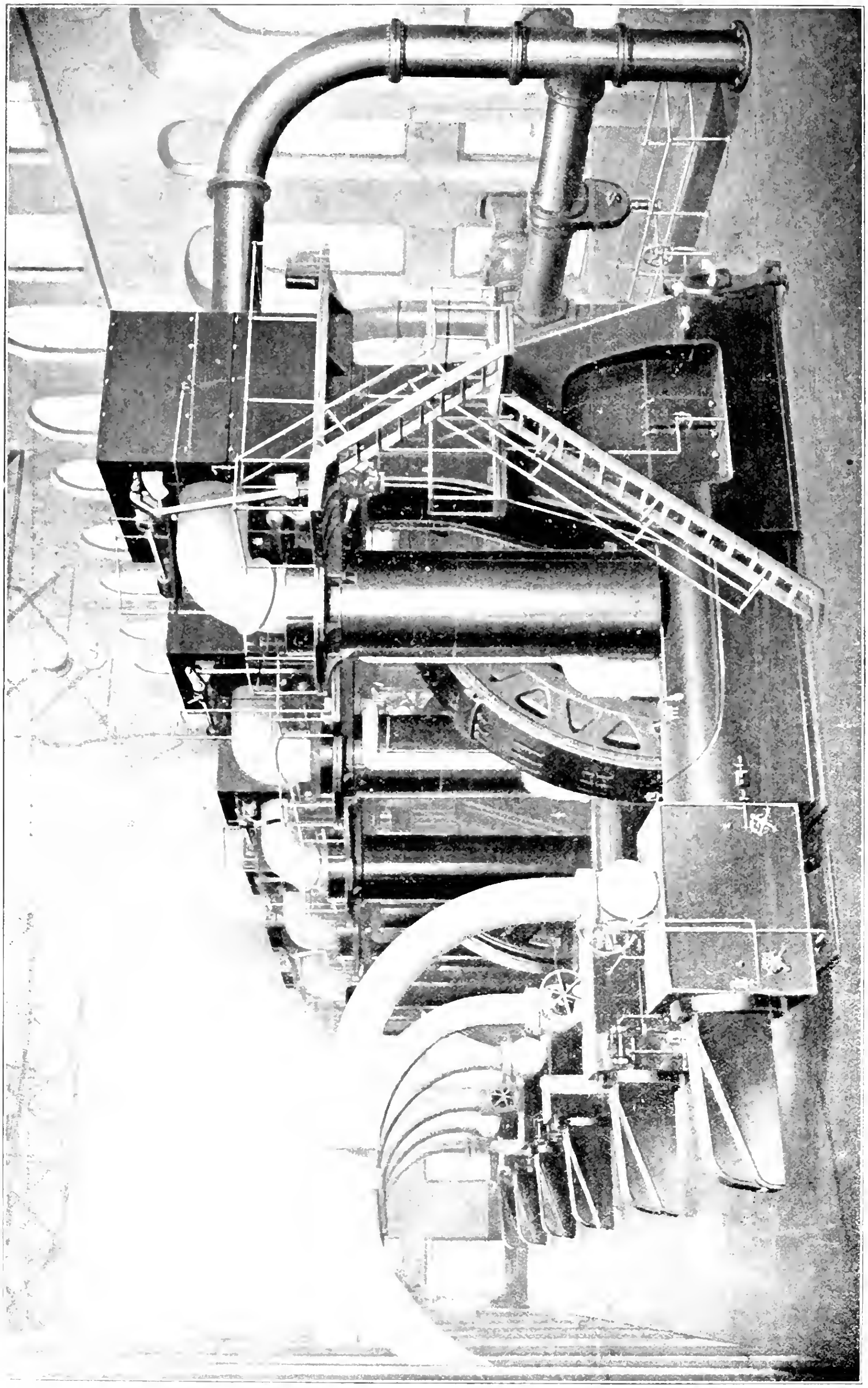
The object of this paper is to deal with the practical side of the question of selecting prime movers, basing the arguments for or against a particular type state here that the criticisms offered with reference to certain types destined to operate under a given set of conditions, have been based upon results gathered from



Steam Turbine and Auxiliary Equipment, Monterey County Gas and Electric Company.

upon actual operating conditions as they exist at present in some of the best known plants. It is well to some of the most prominent power plant superintendents and operating engineers. These results point to certain conclusions. The conclusions which many draw, however, are found to differ with the individual,

[1]Paper read before Los Angeles Section American Institute of Electrical Engineers, April 20, 1909.



Reciprocating Engines in Redondo Plant Pacific Light and Power Company.

and are for the most part at variance among engineers to such an extent that the selection of prime movers is bound to remain a more or less perplexing problem.

Since the greatest source of loss in the power station is to be found within the prime mover this piece of apparatus has constantly received most careful attention. Reliability is fully as important as economy and in a large power station both are necessary.

Considering first the steam prime mover the question of the steam turbine versus the reciprocating engine at once presents itself. Not a few engineers have attempted to settle this question once for all, advocating one type for practically all power plants. The disciple of the steam turbine is rather reluctant to admit that a reciprocating engine should ever have been born, and vice versa. As a matter of fact, each type possesses certain advantages over the other, and in making a choice these should be weighed carefully with reference to the specific conditions in hand.

The reciprocating engine, although considered quite unfit for many plants, is bound to perform valuable service for a great many years to come. Steam pumping plants will, for example, continue to use reciprocating engines, as will also a great many mills and factories in which the speed conditions demand such a type. The steam turbine, however, is an active competitor of the reciprocating engine and is already supplanting the latter in many places where it formerly held "full sway."

It should be remembered that while the steam turbine is probably the oldest form of heat motor, yet its practical utility has been realized only within recent years. During this time a great many difficulties have appeared in the commercial working of the turbine, and it may be said that many of these problems are but partially solved. The cost of developing the steam turbine to its present state has been so great that only the larger manufacturers have been able to handle turbine installations on a commercial scale. The early operation of steam turbines in various power stations revealed their weak points, many of which have been remedied in subsequent machines. Certain objections demand further changes before the turbine may be said to have reached its highest state of development. For this reason it is not unreasonable to suppose that a steam turbine plant erected today is not unlikely to be further out of date five or six years hence, than a reciprocating plant. The many advantages of the turbine, however, and its satisfactory operation in a great many plants are sufficient evidence to show that the question of future development has no direct bearing on present day turbine installations as far as a handicap is concerned.

The field for the steam turbine is essentially that of high speed direct drive. It is its adaptability to this class of service which so eminently fits it for the generation of electric power. Small floor space, freedom from vibration, absence of oil in the exhaust steam, and—above all—the ease with which synchronism is affected, are factors which contribute to its favor for power station work.

With regard to steam economy as compared to the Corliss engine there is still some discussion. Tests have shown some excellent results, especially those made on large turbines. Curves obtained show a comparatively low steam consumption per k. w. hr. over a wide range of load. A steam turbine is not economical, however, on a low vacuum. Steam turbines therefore demand the very best class of auxiliaries if steam economy is to be attained. Otherwise the steam consumption is apt to reach a prohibitive value.

In view of the fact that turbine economy is a function of vacuum the cost of maintenance on auxiliary apparatus for steam turbines is an item of great importance. As to the present status of Corliss engine operation it may be stated that even with large units it is not always advisable to carry the vacuum beyond 27 inches, for the reason that the cost of maintenance on auxiliaries is likely to offset the advantages of lower steam consumption. A steam turbine of less than 1000 k. w. is not likely to show better steam economy than a first-class compound engine of the same capacity, and having the same cost of maintenance. In fact, a turbine of this capacity under ordinary conditions of operation is likely to have a higher steam consumption. In this connection it should be noted that steam turbines of small capacity have relatively large clearances, and this factor alone necessarily introduces a barrier in the way of high steam economy.

In power stations which permit the installation of units of 2000 k. w. and above, the advantages of the steam turbine will usually outweigh those of the reciprocating engine, barring the latter from consideration. In a large power station the cost of the building may be reduced from 20 to 50 per cent by the installation of turbines, when compared to a reciprocating plant of the same capacity. Since the piping for a steam turbine plant is simpler and more direct, a considerable saving may be effected over that of the engine plant. It is interesting to observe both a reduction in first cost and a marked simplicity in the layout of the so-called "double deck" type of plant.

In regard to the question of maintenance it would be reasonable to suppose that the steam turbine has the advantage over the engine, and this is true where the conditions are favorable. A great many if not the majority of breakdowns occurring to steam turbines have come about from one of two causes: either their operation has been placed in the hands of an underintelligent or indifferent class of help, or those in authority have made the conditions for good operation impossible. In such cases the writer is of the opinion that it is strictly "up to the management" and cannot be laid to the fault of the turbine. With proper care (and this means the employment of responsible operators) there is no reason why a steam turbine should not give excellent service, and such service can justly be expected in plants where the operators are properly paid for their work and allowed the opportunity to give the machinery they look after proper care.

Due to the fact that steam turbine efficiency depends upon the condition of the auxiliaries it becomes evident that turbine installations cannot be economically considered where there is not an ample supply of cooling water available. For a suitable vacuum a quantity of cooling water from 60 to 80 times the weight of steam condensed is required.

As regards the question of using superheated steam it may be said that few of the up-to-date plants

above 5000 k. w. are operating without superheat. The theoretical amount of superheat required to prevent condensation is the quantity which will give dry steam at the point of cut-off in the low pressure cylinder at average load for a reciprocating plant, and for a turbine plant an amount which will keep the steam dry to the point of exhausting into the condenser.

A steam turbine is capable of using highly superheated steam to advantage. In the case of the average Corliss or automatic cut-off engine of American manufacture the safe limit to which superheat can be carried is restricted to about 100 degrees F. Higher superheats in this type of engine require special fittings. On the continent of Europe much higher superheat is employed, superheats of 200 degrees and over not being uncommon. Economic conditions in America are vastly different from those in Europe, and this is accountable for many features in connection with European plant operation not to be found in the United States. Engineering requirements in this country are such that the time for building a plant and putting it in operation is usually so restricted as to preclude many of the refinements which would greatly improve the economy.

In not a few cases the selection of prime movers is made on a basis of the time of delivery. This is particularly true of plants located at points remote from manufacturing centers. It is the tendency of many who control power enterprises to increase the output almost to the point of a burnout before any arrangement is made to enlarge the plant, with the result that before the plans for an addition are fairly under way the existing machinery is groaning under the load it has to carry.

Under these circumstances the purchase of second-hand machinery may be justifiable when considered from the standpoint of emergency, since the cost of a long delay, the cost of new machinery, and the interest on the investment may be decidedly unfavorable as compared to meeting the exigency through a quicker and cheaper means. It is needless to say that such an emergency should not be allowed to arise. If it does, however, the only method of meeting it is to consider the immediate requirements and take the initiative.

It is well here to touch upon the advantages of the exhaust steam turbine as a means of enlarging the output of existing reciprocating plants. It is well known that, due to constructive difficulties, the expansion of steam within cylinders is greatly restricted. For example, if steam at 150 pounds pressure is expanded to one pound absolute (28 inches of vacuum) the volume must increase 111 times. If this number of expansions were carried out within the cylinders of a compound engine the low pressure cylinder would require a diameter ten and a half times that of the high pressure, which for mechanical reasons is out of the question. A steam turbine, however, will permit an expansion of 150 times the original volume without difficulty. It is plain, therefore, that if a low pressure turbine be interposed between the low pressure cylinder and the exhaust pipe to the condenser, the energy which is ordinarily rejected becomes immediately available for the generation of power. By this method the present day reciprocating plant may increase its output as much as 100 per cent at comparatively small cost and with but little inconvenience. A number of exhaust steam turbine installations have been made, and a large number of others are being seriously considered.

One of the most important requisites of a prime mover is its ability to respond quickly to overloads. This requirement is of extreme importance in electric railway service, as the load conditions are as a rule the most trying to be reckoned with in any power system. That the steam turbine is well adapted to such service was demonstrated in the case of one of the large New York City plants of the Interborough Rapid Transit Company, and was described by Mr. H. G. Stott in his admirable paper on "Power Plant Economies." It may be reiterated briefly as follows: A steam turbine was thrown in parallel with a double compound engine carrying a railway load. It was noted that momentary overloads were carried almost entirely by the turbine, while the engine load remained nearly constant. In other words the action of the turbine was much like that of a storage battery. The advantages of such a combination are unusually striking, and show with what sensitiveness the steam turbine responds to the most exacting conditions of service.

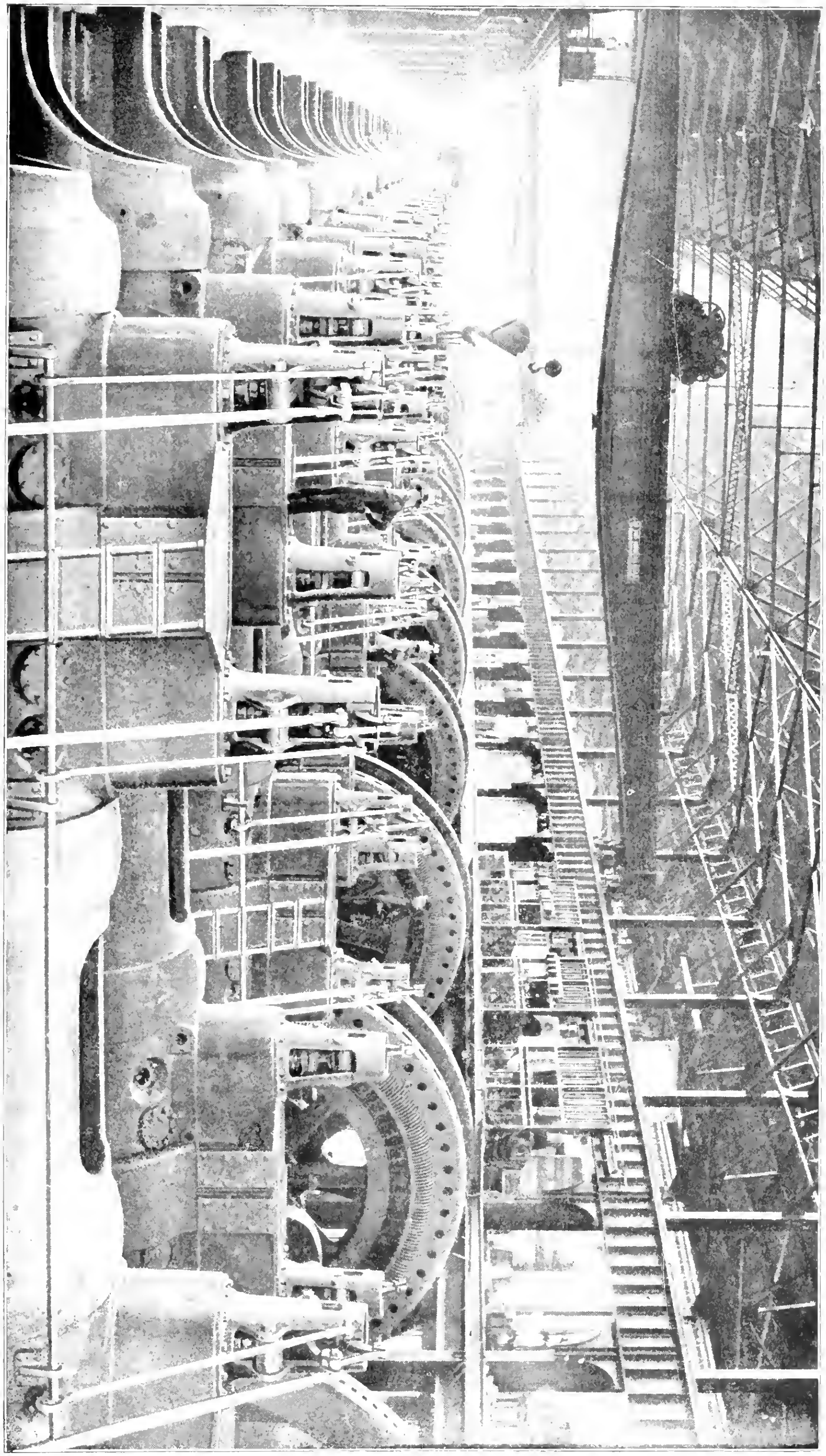
A great deal more might be said concerning steam prime movers on both sides of the case, but what remains to be said should be taken up by those amply able to bring into view many facts not even mentioned in this paper.

The advent of gas power into the central station field is not only creating intense interest among power users but is compelling most careful consideration in making a choice of prime movers in a great many localities. That the gas engine has been re tricted to a certain class of service cannot be denied. Its scope of usefulness, however, is rapidly extending, and it is already supplanting the steam prime mover in many places where the latter until recently had no competition. The thermal efficiency of the gas engine is admittedly higher by 100 per cent or more, than the best compound condensing steam engine or steam turbine. The main objections to the gas engine as a prime mover for electric power plant service have been:

(1) Non-uniform speed.
(2) Inability to carry overloads.
(3) Unreliability of service.

The first item, that of non-uniform speed is of course decidedly against the first requirement for electric power service. As to the question of speed regulation there is no prime mover in existence, and never will be which is capable of perfectly uniform rotary motion. Perfect speed regulation means that after the proper velocity has been reached the acceleration must remain zero. It is obvious that this is mechanically impossible. In the case of a gas engine the mechanical difficulties of regulation are enhanced by thermal difficulties, especially those relating to the four stroke cycle. This has been overcome very largely by the employment of two or more cylinders, and by increasing the fly wheel effect.

With two or more cylinders—either in tandem or parallel—and sensitive governing mechanism, a gas



Gas Engines at Indiana Steel Company's Plant, Gary, Ind.

engine is capable of good regulation up to full load. Beyond full load there is very little margin, and as the load increases the engine will drop in speed. This is due largely to the fact that the amount of gas required to form an explosive mixture is not in direct proportion to the load, the range of economical working being from 50 per cent load to full load or a trifle above. The quantity of gas drawn into the cylinder beyond a certain point ceases to increase the power of the engine, and will decrease it with a rich as well as a lean mixture.

Mr. Stott has suggested a combination plant made up of 50 per cent gas engines and 50 per cent steam turbines, the latter using steam which is generated from boilers having their feed water heated by means of the gas engine jackets. The quantity of jacket water required by a gas engine varies from 7 gallons to 8½ gallons per brake horsepower hour or from 75 to 95 pounds per k. w. hour respectively, depending upon the initial and final temperatures. Assuming that the turbines will use say 18 pounds of steam per k. w. hour (running condensing) it is apparent that but one-fourth of the heat energy of the jacket water is available. This would be almost entirely offset by the cooling water demanded by the condensers, since the enormous quantity required in addition to that necessary for the gas engines would introduce complexities likely to annihilate the economy sought. Even if the turbines were to run non-condensing it is doubtful whether the difficulties of handling the cooling water would not increase the investment to a figure quite prohibitive for most localities. In addition to this problem there remains the fact that a power station having two totally different types of prime mover is bound to be hampered by complexities not encountered with a uniform layout.

At the present time the gas engine unquestionably offers the best solution to the problem of fuel economy. The advantages of gas power in the neighborhood of coke ovens and blast furnaces need no comment. In this case the gas engine holds the field practically without competition.

With reference to the first cost of a gas power plant as compared to a steam plant Prof. R. H. Fernald has drawn the following conclusions: Gas engine plants of less than 1000 horsepower capacity are from 15 to 30 per cent greater than corresponding steam plants. Due to lower cost of operation this difference may be made up within from two to three years. With plants of from 1000 to 5000 horsepower the first cost favors steam from 5 to 15 per cent, the difference being made up in from one to two years. In the case of plants of more than 5000 horsepower capacity the initial cost is approximately the same for both types. The result is therefore a gain both in efficiency and in cost of operation of the gas power plant.

A 5500 horsepower gas engine plant has been constructed for a total cost per horsepower of $73. The same plant considered steam upon which a bid of $74 per initial horsepower was made. These figures seem to point to but one conclusion as far as plants above [illegible] horsepower are concerned. In the commercial [illegible] of gas power plants there still remain certain obstacles which are of a sufficiently serious nature to cause some doubt as to the question of continuity of service. Some serious problems remain to be solved in connection with the gas producer before that part of the plant may be said to have reached its highest state of satisfaction. The rapid extension of gas power, however, especially in connection with some of the largest power projects are answers to the question of reliability.

TRANSMISSION LINE FORMULAE.

T. R. ROSEBRUGH, M. A.

In making any calculation one may hesitate between a method which neglects quantities that may possibly need to be taken into account, and one which while dealing completely with the problem, is more laborious or intricate, and thus increases the chances of error. The advantage of the method to be described is that it permits a middle course, yielding first a rough result coinciding with that of simpler expressions, to be followed subsequently as far as may be desired, by rough approximations rapidly converging to the true result as term after term is estimated.

The result may be obtained graphically or analytically as may be preferred by the following method.

First reduce the problem, if it relates to three-phase transmission, to one of single phase.

If the connection be star, then in so far as the fundamental is concerned, the neutral points (one at each end) will be at the same potential, and may be treated as if in immediate contact. One-third of the power may then be taken as transmitted by each conductor at the voltage which exists between it and the neutral point, that is line voltage divided by $\sqrt{3}$.

The resistance and reactance are seen to be those of one conductor only, while the capacity and leakage conductance, with which we have to do are estimated as the individual branches of a star connection having their common terminals on an imaginary neutral carrying no current.

In the calculation it is indifferent whether the actual arrangement be delta or star.

It is not the purpose of this paper to deal with these line constants, but a few words of caution may not be out of place. In using tables individual numbers may be in error, or a mistake may be made by using a table calculated on a different basis, perhaps with some coefficient not properly belonging, incorporated with it, and the special method of using such table not quoted from the original source.

Let r = resistance of one conductor.
x = reactance of one conductor.
g = leakage conductance.
b = susceptance.

If x be taken from a table, it should be, for the present purpose, one giving the reactance of one conductor at the given frequency, in accordance with

$$x = L\omega = \frac{160930}{10^9}\left(2\log_e\frac{2D}{d} + \frac{1}{2}\right) m\,\omega \text{ henries,}$$

where m is the distance of transmission in miles, by stating its value for one mile, or otherwise.

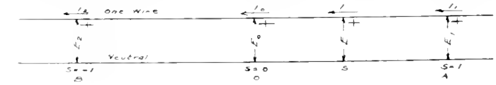
Also $b = C\omega$ should, if obtained from a table, be from one giving values agreeing with

$$C \times 10^6 = \frac{160930}{900000}\, m \div 2\log_e\frac{2D}{d} \text{ microfarads.}$$

These preliminaries being arranged, and

$$z = r + x\,j$$
$$y = g + b\,j$$

adopted for abbreviation, take E_0 and I_0 to denote the vectors describing voltage and current respectively at one end of the



line, which for definiteness may be thought of for the present

as the receiving end at O in the figure, and taken as the origin.

Take E_1 and I_1 of corresponding meaning for the other end A at $s = 1$. E and I similarly may be taken as vectors for the arbitrary point on the line whose distance from O is s.

The diagram shows the convention adopted for the signs: that is, positive instantaneous values of voltage and current are taken to be of the polarity and sense respectively indicated by the + and the arrow, and relative vector senses chosen accordingly.

Here E and I being functions of s they are given thus by Taylor's theorem:

$$E = E_0 + s\left(\frac{dE}{ds}\right) + \frac{s^2}{2}\left(\frac{d^2E}{ds^2}\right) + \frac{s^3}{6}\left(\frac{d^3E}{ds^3}\right)_0$$

or for short, D denoting differentiation once with regard to s, D^2 twice, etc.

$$E = E_0 + s\,(DE)_0 + \frac{s^2}{2}\,(D^2E)_0 + \frac{s^3}{6}\,(D^3E)_0$$

$$I = I_0 + s(DI)_0 + \frac{s^2}{2}\,(D^2I)_0 + \frac{s^3}{6}\,(D^3I)_0$$

These values may be readily determined thus: With the current as at s remaining constant at the value I the vector voltage difference for the conductor would be zI for the whole length of the line, that is for unit length as we have chosen to call it, so, and consequently $\frac{dE}{ds} = zI$, or for short $DE = zI$. Similarly $DI = yE$.

Hence $D^2E = D.DE = DzI = zyE$

$D^3E = D.D^2E = DzyE = z^2yI$

$D^4E = D.D^3E = Dz^2yI = z^2y^2E$

$D^2I = D.DI = DyE = yzI$

$D^3I = D.D^2I = DyzI = y^2zE$

$D^4I = D.D^3I = Dy^2zE = y^2z^2I$

Therefore $E = E_0 + szI_0 + \frac{s^2}{2}\,syE_0 + \frac{s^3}{6}\,z^2yI_0 +$

and $I = I_0 + syE_0 + \frac{s^2}{2}\,yzI_0 + \frac{s^3}{6}\,y^2zE_0$

In particular at A the end of the line ($s = 1$)

$$E_1 = E_0 + zI_0 + \frac{1}{2}\,syE_0 + \frac{1}{6}\,z^2yI_0$$

$$I_1 = I_0 + yE_0 + \frac{1}{2}\,yzI_0 + \frac{1}{6}\,y^2zE_0$$

By means of these two expressions the problem (so far as fundamental frequency is concerned) may be solved as accurately as the data permit, for any length of line.

As the length and voltage increase it may be necessary to take in successively additional terms; this may be carried to any extent desired.

The first term for I_1, and the first two for E_1 give the ordinary solution for short lines at low voltage. The second term for I namely $yE_0 = (g + bj)\,E_0$ corrects the current for leakage and effect of capacity. The third term for E_1 corrects the drop already calculated for constant current by taking account of its variation along the line due to leakage and capacity. The third term for I_1, corrects the error made in calculating leakage and capacity effect on the basis of constant potential throughout.

At or before this point, the requirements of calculations of power transmission are likely to be satisfied, but telephonic transmission with the high frequency of some of the components of sound necessary for clear enunciation, and the long distances which are common may demand several terms more.

It is unnecessary to discuss at length the method of using this formula, as the use of complex quantities is explained in many text books.

Briefly, however, it may be stated as a caution that while the laws of algebra may be applied to the expressions given, yet if E_0 is to be taken directly as a number, I_0 (not usually being a vector in the same direction) may not be. For example, if the current be 100 amperes at O, and be lagging so as to have a power factor of 90%, then if E_0 be represented by its value in volts as a pure number, $I_0 = 100\,p - 100\,qj$ where $p = 90$ and $p^2 + q^2 = 1$.

Thus the data may for symmetry be supposed stated in the form

$$E_0 = A_0 + B_0\,j$$
$$I_0 = M_0 + N_0\,j$$

There finally result from the above described calculation

$$E_1 = A_1 + B_1\,j$$
$$I_1 = M_1 + N_1\,j$$

As line drop is stated as the arithmetical difference in value of the line voltages it will be (when only the fundamental is considered)

$$\sqrt{A_1^2 + B_1^2} - \sqrt{A_0^2 + B_0^2}$$

The power transmitted will be $A_0M_0 + B_0N_0$ watts, and that received $A_1M_1 + B_1N_1$, from which the efficiency is at once found in per cent. $100\,\frac{A_0M_0 + B_0N_0}{A_1M_1 + B_1N_1}$

The power factor at A will be

$$(A_1M_1 + B_1N_1) \div \sqrt{A_1^2 + B_1^2}\,\sqrt{M_1^2 + N_1^2}$$

Again suppose the data given relate to the point O supplying power to the other end B of the line under given conditions represented by the same diagram as before. Then as every point on a continuous line may be considered as receiving power on one side and giving it out on the other, the point O may be so considered and the conditions at B found by inserting $s = -1$ in the formula. This will have the effect of changing from + to − the sign of each even numbered (odd powered) term in both the series given.

Therefore when the vectors E_0 and I_0 are given for the point O, E_2 and I_2 for the other end B of the line of the same length as before will be given by

$$E_2 = E_0 - zI_0 + \frac{1}{2}\,zyE_0 - \frac{1}{6}\,z^2y_0I +$$

$$I_2 = I_0 - yE_0 + \frac{1}{2}\,yzI_0 - \frac{1}{6}\,y^2zE_0 +$$

These may be dealt with similarly.

WILL BUILD TUNGSTEN REFINERY.

Operations on the Melvin group of tungsten claims at Round Mountain, Nevada, aggregate a total of 850 feet of work in the three crosscut tunnels which have cut a belt estimated to be from 150 to 175 feet wide containing a large number of veins and stringers carrying from three to 36 inches of tungsten ore. The three tunnel dumps have several thousand tons of ore which will average \$25. At least 50 veins have been cut in the three tunnels of varying width. The values run up from \$6 to \$300 a ton at a conservative estimate. There is a large amount of ore that will average 12 per cent and make a fine milling product. Manager Gohlin expects to start a raise in No. 3 tunnel 150 feet in from the mouth of the tunnel. The raise will be 175 feet to the surface. The glory hole method will be used in handling the ore, chuting down into the tunnel, where a grizzly will be used to good advantage in preparing the rock for use at the mill that is now a certainty. The style of rollers for the mill have been decided on and are now being manufactured. Manager Gohlin is also in communication with machinery manufacturers in the East arranging for a new and improved style of separator, and when the details of that are settled the plans for the mill will soon be under way and Round Mountain will soon be known as a producer of tungstic acid and have the honor of possessing the second mill in the United States for the production and treatment of that useful metal. The only mill now refining tungsten ores is situated at Boulder, Colo. Plans are also under way for building a mill at Spokane, Wash., to treat the tungsten ores produced at Murray, Idaho, and Deer Park, Wash.

PRELIMINARY DESIGNS OF TURBINE INSTALLATIONS.[1]

BY N. BAASHUUS.

From the effective head H in meters and the quantity of water Q in cubic meters per second, the total output of the turbine is approximately,

$$N' = 10 \times Q \times H$$

At the present time the two types of turbines most used are the Francis turbines for heads from 1 to 100 meters, and Impulse wheels for heads from 50 to 500 meters.

The efficiency of the Francis turbine for any given case can easily be found for any effective head H in meters; any desired output N in horsepower, and any number of revolutions n per minute. These three factors form in a certain connection a constant figure, the so-called characteristic, from which the efficiency of the turbine can be judged. This constant reads as follows:

$$kN = \frac{n}{H}\sqrt{\frac{N}{\sqrt{H}}}$$

the value of which can easily be figured out by means of the slide rule. The characteristic by any given head is in direct proportion to the number of revolutions and to the square root of the output. The output and number of r. p. m. are factors determining the dimensions of the turbine and with these the losses change so that the characteristic forms an expression for the efficiency of the turbine. From the formulae of the characteristic is evident that the same is independent of the diameter and of the size of the turbine. This is not exactly true but is near enough for any practical case. It should also be pointed out that the characteristic is independent of the head under which the turbine operates. If a turbine works on a different head, the number of revolutions is also changed and at the same time the total output, so that kN always remains constant. In the following table is given a series of characteristics for Francis turbines, and underneath each characteristic the corresponding efficiency appears. The first named corresponds to only one guide wheel and one runner. The last named are average values which can be regarded as possible to reach in good installation. Many times values can be found in the literature which are still higher than those given.

kN	350	325	300	275	250	225	200	175	150	125	100	75	50
Efficiency	75	76	77	78	79	80	81	82	83	84	84	82	80

A high characteristic 350 to 250 is the evidence of high speed runners. A low characteristic 75 to 50 is evidence of low speed runners. As is seen from the table the highest efficiency is reached by using the middle characteristic, therefore the choice of output and number of revolutions for each unit should be so, that this middle characteristic can be used. By very low head the turbine would in this case run too slow and be too large and expensive, while with very high heads it would run too fast. In the first case one is compelled to use the high speed runner or use more guiding wheels and runners on one shaft. In the second case one must use the slow running Francis turbine or perhaps use the Impulse wheel. The placing of more guiding wheels and runners on a common shaft is the best method to increase the number of revolutions per minute and thereby get a higher efficiency as well by full as by partial gate opening. Should, for instance, a generator that makes 175 revolutions per minute and takes 1000 horsepower be driven from a turbine under an effective head of two meters, so is the characteristic,

$$kN = \frac{175}{\sqrt{2}}\sqrt{\frac{1000}{\sqrt{2}}} = 250$$

If the turbine is only provided with one guide wheel and one runner, then is seen, from table above, that for such turbines the efficiency would be about 79 per cent. If this should be thought to be too little, or if higher efficiency with partial gate opening is wanted, it would be best to use a twin turbine. In this case we have only one-half the power on each wheel. The corresponding characteristic would be as follows:

$$kN = \frac{175}{\sqrt{2}}\sqrt{\frac{500}{\sqrt{2}}} = \frac{250}{\sqrt{2}} = 175$$

corresponding to an efficiency of 82 per cent. If the number of runners are still further multiplied we get three or four ply turbines. A turbine with three runners has the following characteristic:

$$\frac{250}{\sqrt{3}} = 150$$

while the turbine with four runners has the characteristic:

$$\frac{250}{\sqrt{4}} = 125$$

In the last case the runners should be so constructed that one or more could be cut out during low water season, using the water at hand to the best efficiency in the remaining wheels.

The efficiency of an Impulse turbine changes with the dimension of the unit in the same way as does the efficiency for a Francis turbine, so that the characteristic also in this case gives information about the efficiency. The table below can be used as a guide:

kN =	20	17.5	15	12.5	10	7.5	5	(Approx. 2% low for
Efficiency =	75	76	77	78	79	80	81%	American designs)

This characteristic corresponds to only one nozzle and the efficiencies are average values which in good installation can be regarded as possible to reach. In the same way as on the Francis turbine more nozzles can be put on one runner or more wheels can be put on the same shaft. In this way we can reach a given number of revolutions per minute at any desired efficiency or a higher efficiency can be reached at any speed.[2]

Should, for instance, 400 horsepower be given off at an efficiency of at least 77 per cent with an effective head of 75 meters, the turbine could be designed in the following way: From the table is seen that the tur-

[1] T[illegible] Electrotechnische Zeitschrift, October [illegible] 190[illegible]

[2] Not possible in American designs.

bine must have a characteristic of about 15. The number of revolutions per minute is then,

$$n = k N \times H \times \sqrt{\frac{\sqrt{H}}{N}} = 15 \times 75 \sqrt{\frac{\sqrt{75}}{400}} = 166$$

This seems too low, therefore two nozzles on one wheel is chosen. Each gives off 200 horsepower and the corresponding speed is calculated as follows:

$$166\sqrt{2} = 235$$

with four nozzles on two wheels the corresponding speed is given

$$166\sqrt{4} = 332$$

and with six nozzles on three or only two runners, the speed is

$$166\sqrt{6} = 400$$

Because N is equal in all these cases the turbines will practically have the same efficiency, 77 per cent, also their dimensions and speed varies considerably.

TUNGSTEN VS. OTHER FORMS OF STREET LIGHTING.[1]

BY E. L. SHERWOOD.

The customary practice in electric street lighting is in the use of the series constant current system, on account of the lower cost of line construction and lesser loss in distribution. Heretofore two series systems were found necessary, one for arc lamp circuits

Fig. 1. Tungsten Lamps for Series Lighting.

requiring 6.6, 7.5 or 9.6 amperes, and the other for incandescent lamp circuits (Carbon or Gem) of lower current values such as 1.75, 3, 3.5 or 5.5 amperes. This was necessitated on account of the short life and higher cost of high ampere incandescent lamps, but when the tungsten series lamp was developed it was found that the high ampere lamps were just as good as the low ampere, in fact they are a little more rugged. This gives the tungsten an important advantage over the carbon or gem lamps, as now, should an incandescent lamp be desired at any point, it can be looped in on the arc circuit, and give perfect satisfaction.

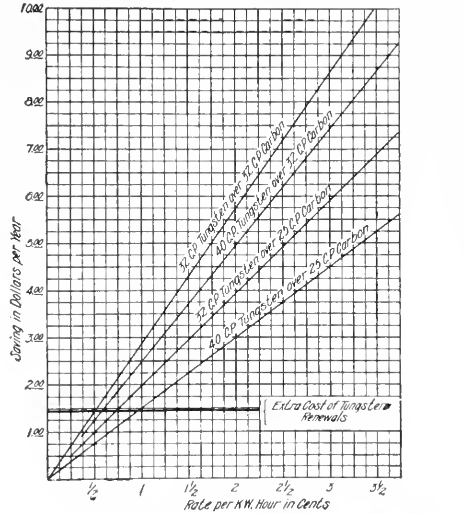


Fig. 2. Annual Saving Tungsten Series Lamps vs. Carbon Series Lamps.

Another point in favor of the tungsten lamp is in its extremely long life giving in service from 1500 to 2000 hours on an average, and with practically no depreciation in candlepower. This not only means

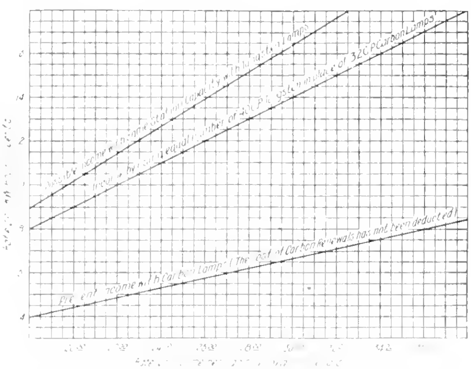


Fig. 3. Gain in Income Tungsten vs. Carbon Series Lamp.

that a lamp requires trimming but two or three times a year with the consequent saving in labor of trimming and patrolling, but the lamp can be depended on to give a brilliant light until it fails.

As is probably well known, the tungsten lamp has the extremely high efficiency of 1¼ watts per candle, being twice the efficiency of the Gem lamp and about three times the efficiency of the carbon incandescent lamp. On account of its high efficiency and low labor cost of trimming, a large number of central stations,

[1]Paper read at May meeting Los Angeles Section American Institute of Electrical Engineers.

notably those in New England, have been replacing their arcs with clusters of tungsten lamps, or by more frequently spaced individual tungsten lamps, thereby obtaining a better distribution of light, and at a lesser cost.

In reviewing the sales of incandescent street lamps for the past year, it is interesting to note that not only have the total sales of all the manufacturers more than doubled, but about eighty-five per cent of the lamps sold were tungsten. The former is probably due to the stimulus given to street lighting by the introduction of the tungsten lamp, and the latter undoubtedly due to the tremendous saving made by the cental station in the tungsten lamp.

seen that the net income for current, after the cost of all lamp renewals has been deducted is from 4¼c to 5c per k. w. h. with the 40 c. p. carbon lamp, and from 10¾c to 13½c per k. w. h. with the 40 c. p. tungsten lamp. These rates for the tungsten lamp should certainly show a profit to the central station, considering the character of the service. Even with the 60 c. p. lamp which certainly gives much better service than the mantle lamp, the net income is from 2 2-3c to 3 1-3c per k. w. h. with the carbon and 7¼c to 9c per k. w. h. with the tungsten lamp.

can be made where several transformers are used, by bunching several circuits on one transformer, thereby cutting out the core losses of the transformers not used,

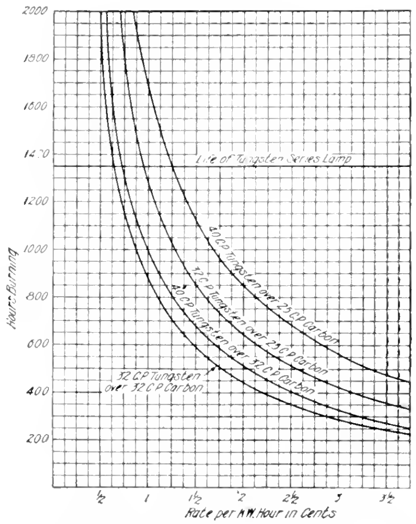


Fig. 4. Life Necessary to Compensate for Increased First Cost of Tungsten Over Carbon Series Lamps.

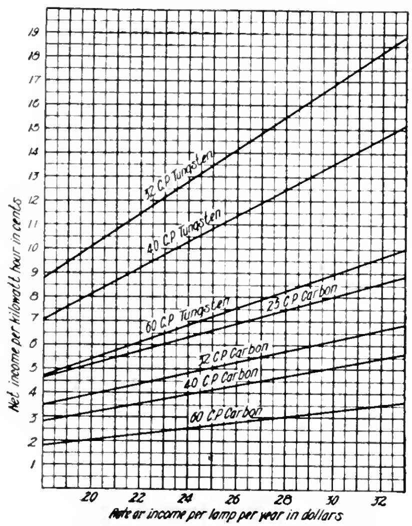


Fig. 5. Net Income per Kilowatt Hour, Tungsten and Carbon Series Lamps.

In order to show the foregoing statements, let us look at Fig. 2, which shows the gross saving in 4000 hours yearly service (all night every night) of tungsten over carbon lamps. The basis of the figuring is that the renewals of lamps per year are four (a low average) for the carbon lamp, and three (a high average) for the tungsten lamp. The costs of the lamps are based on standard package quantities only, and hence central stations purchasing $175 or more net value of all lamps will obtain a lower cost of renewal. By referring to the curve it will be seen that at 1½c per kilowatt hour, the usual cost of current, the yearly gross saving for 32 candle-power lamp is $4.32. The extra cost of renewals per year is $1.85 for the tungsten, so that the net saving is the difference, or about $2.50 per lamp per year.

In addition to this annual saving, the station apparatus (constant current transformers, etc.) has about three times the capacity in number of lamps, so that for the same investment in the station, three times the revenue can be obtained by getting contracts for the extra number of lamps possible, which usually can be done on account of the better service given. If this is not possible, a still greater saving

and using them as spare transformers in case of a breakdown. Often it can be arranged to have a full load on one or more transformers, instead of a partial load on several transformers, thereby increasing the power factor as a whole. In new installations, not only is there a lesser amount of energy required per lamp, but a lesser investment cost is required.

By a similar process of reasoning it can easily be figured out just how long a tungsten lamp must last to exactly save its increased cost of renewal. The curves in figure 4 are based on the same figures as before, and it will be seen therefore that at a cost of 1½c per k. w. h., the tungsten lamp must last 600 hours to break even. Should it last any longer, every hour represents a saving.

In competition with the gas or gasoline mantle lamp, the usual cost per lamp year for the mantle lamp varies from $25 to $30. From the curves in figure 6 which are based on 4000 hours yearly service, it is

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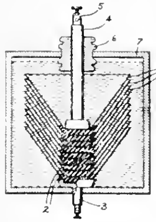
Street Railway Men's Day at the A. Y. P. Exposition at Seattle will be June 28. The Seattle Electric Company will arrange its schedules so that all its employes can visit the fair on that day.

PATENTS

923,774. **Electrolytic Cell or Condenser.** Elmer E. F. Creighton, Schenectady, N. Y., to General Electric Company.

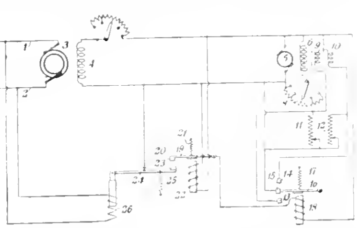


An electrolytic condenser comprising a plurality of oxidizable cups separated by an electrolyte containing citric acid.

923,284. **Socket-Lock for Incandescent Lamps.** Abbott L. Lowe, Denver, Colo. The combination with an incandescent lamp and socket or holder, of an insulating flanged sleeve inserted in an opening formed in the side, said sleeve having a

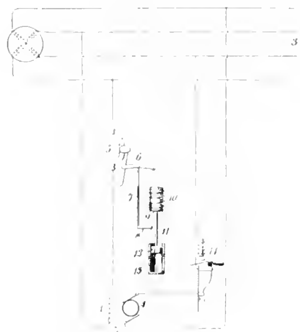
lug engaging the recess formed in the shell of the socket to prevent the rotation of the sleeve, an inner sleeve mounted in the insulating sleeve having a central interiorly threaded portion, a locking pin threaded in the latter and adapted to enter an opening formed in the neck of the lamp for the purpose set forth.

923,627. **Voltage-Regulator.** Frank Conrad, Swissvale, Pa., assignor to Westinghouse Electric and Manufacturing Company. The combination with an electrical circuit, and a dynamo-electric machine connected thereto, of an exciter



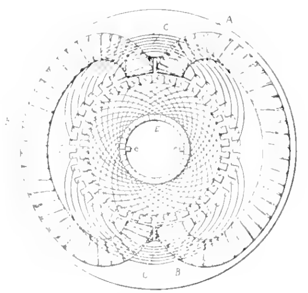
generator having a main field magnet winding and two auxiliary field magnet windings arranged to act in opposition, resistances in circuit with the respective auxiliary field magnet windings and means responsive in operation to variations in the voltage of said circuit for shunting the one or the other of the resistances.

923,666. **Protective Device for Commutator-Type Alternating-Current Motors.** Benjamin G. Lamme, Pittsburg, Pa., assignor to Westinghouse Electric and Manufacturing Company. The combination with a commutator-type motor having armature and field magnet windings separately supplied



with alternating currents, of an interrupter in the field magnet circuit, a tripping device therefor that is retained in inactive relation by the armature current, and means for delaying the action of the tripping device until a predetermined interval of time has elapsed after the opening of the armature circuit.

923,311. **Electric Motor.** Ernst F. W. Alexanderson, Schenectady, N. Y., assignor to General Electric Company. In a dynamo-electric machine, a field magnet having polar projections, main field coils carried in the interpolar spaces, a



compensating winding distributed on the pole faces, an armature provided with a commutator, and armature coils having a fractional pitch equal to the breadth of the pole faces.

918,660. **Intercommunicating Trunking System.** Elmer R. Corwin, Chicago, Ill., assignor to Corwin Telephone Manufacturing Company, Chicago, Ill. An intercommunicating telephone system having a plurality of local lines common to a plurality of stations, a trunk line extending from the intercommunicating system to a magnetic exchange, a repeating coil inductively connecting one of the said local lines with the trunk line whereby conversation may be carried on from the various said stations over the trunk line, a kick-coil having one winding bridged across the trunk line at the intercommunicating system, and means at the various said stations for causing the kick-coil to throw a drop on the trunk line at the magneto exchange.

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NOTICE TO ADVERTISERS

Changes of advertising copy should reach this office ten days in advance of date of issue. New advertisements will be accepted up to noon of Monday for the paper dated Saturday of the same week. Where proof is to be returned for approval, Eastern advertisers should mail copy at least thirty days in advance of date of issue.

FOUNDED 1887 AS THE
PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

It is difficult to find an article in the technical press which does not contain some comparison of different ways of doing the same thing. Such comparison may be either direct or implied. It is sometimes obvious and sometimes veiled. The advantages of one method are listed against those of another and evidence is presented as to why the one should be adopted. The intent is to show that certain apparatus is better than any other. These articles are usually written by unbiased engineers incorporating the results of their personal experience. But "what is one man's meat is another's poison," and what is one man's success may prove to be another's failure. No method should be adopted or discarded on the dictum of one observer, for we are all liable to err. It is only from a consensus of competent opinion that fair judgment can be given. A method which is acceptable to a theorist may be of little value in practice, whereas the practical "rule of thumb" may prove cumbersome and unsatisfactory for scientific work.

Comparisons

A good machine in poor hands or under adverse conditions may make a poor showing as compared with a less efficient one properly run. This has been demonstrated many times in tests of steam turbines and reciprocating engines. Requirements may differ so that what is good under one set of conditions is of no value under another. An impulse water-wheel would offer little competition to a gas engine in the Sahara desert, and one match would be worth more than a carload of electric cigar-lighters at the South Pole.

Furthermore, it is possible for a method to be at once the best and the worst. An example of such duality was afforded recently in an advertising competition in which the same copy was entered by two people, one of whom considered it the best and the other classifying it as the worst. Both opinions were accompanied by good evidence to support their contentions and both were right—from their own viewpoint. The most brilliant diamond is lusterless in some lights and from certain angles the imitation may rival the genuine.

These examples all show how unstable is the sensitive balance which determines the superior and the inferior. It sways with the slightest change in external conditions, its counterpoise is unprotected and parallax causes many a mistake. Even the equilibrium established by time is liable to change at any moment when some new method, perhaps once condemned, takes the place of the old, tried and true though it be.

CURRENT COMMENT

Attendance at the N. E. L. A. convention last week totalled 2,030 out of a membership of 3,215.

The resistance of shellacked coils varies with changes in atmospheric humidity according to tests of the British National Physical Laboratory.

The cost of electric pumping at Cripple Creek, Colorado, is estimated to be half of that of pumping with steam. A low rate is offered for off-peak use.

The wireless telegraph is to replace the U. S. Government telegraph lines in Alaska which have been kept in repair by the signal corps with difficulty.

Oil tempering baths with electric heat and temperature control up to 600 degrees are being used with the new fused salt type of electric furnace for heating steel.

Stealing electricity in Colorado is punishable by a fine of from $50 to $300 and imprisonment of from 30 to 90 days. Proof of wire connection or injury to the meter is taken as evidence of guilt.

The longest telephone span is claimed to be that crossing Lake Wallenstadt in Switzerland. It is supported by two steel towers 7827 feet apart and at its lowest point is 130 feet above the level of the lake.

The production of mica in the United States during 1908 was worth $267,925, according to the U. S. Geological Survey figures. There were nearly one million pounds of sheet mica and 2417 tons of scrap.

The Northwest Electric Light and Power Association invites all electrical men to make their headquarters at the association's booth in Machinery Hall at the Alaska-Yukon-Pacific Exposition at Seattle this summer.

A strike on St. Petersburg electric railways was started on June 14 when all employes walked out following a refusal for an increase in pay and new arrangement of shifts. The strike is said to have been arranged by the Social Democrats to test their strength.

An electric dynamite thawer is in successful use at the Roosevelt drainage tunnel in Colorado. The powder house is equipped with large electric heaters which raise the temperature of the room to 80 degrees in half an hour at a cost of ten cents daily for electric current.

High tension damage to telegraph lines belonging to the Western Union Company caused them to ask for an injunction against the Chicago, Lake Shore & South Bend Traction Company's operating a high-tension trolley system. This injunction has been denied by the Superior Court of Indiana.

Power site withdrawals aggregating 233,365 acres of public land in Utah, Colorado, Wyoming, Montana, Idaho and Oregon have been approved by Secretary Ballinger in accordance with recommendations made by the U. S. Geological Survey, since April 23d of this year. These withdrawals are temporary, "in aid of proposed legislation affecting the disposal of water-power sites on the public domain."

An electric heating unit adopted for experiments at the British National Physical Laboratory consists of a thin strip of resistance wire wound on a thin sheet of mica, the electrodes of copper strip being threaded into the mica and soldered to the resistance strip. A thin sheet of mica is laid on each side and sewed round the edges, and the whole is slipped into a thin copper envelope, which is let into and soldered to the lower side of the bath. The unit can be easily removed for renewal or repair without moving or emptying the bath.

Electro-chemical theory of rust is discussed in Bulletin No. 35 of the Department of Agriculture by Allerton S. Cushman. Steel corrosion is said to be the result of electro-chemical action. As priming coatings for preventing rust zinc, barium and lead chromates made the best showing, while lampblack and graphite seemed to stimulate rather than inhibit rust. Varnish and bitumens showed up well. The author believes that concrete prevents corrosion because it contains free lime, and if this is washed out rusting becomes probable. Steel pipe immersed in soggy, sour clays can have its life prolonged by the addition to the clay of 5 per cent of quicklime. Homogeneous steel will resist rust without a protective coating.

Destruction of telephone poles by insects is generally underestimated, as their depredations go on gradually, but forcibly, attracting little observation. When they bore into the timber they open up air chambers and channels which make it easy for rainwater to seep in, and thus keep the wood in a moist condition. Fungus spores floating through the air are enabled to germinate with greater rapidity and with increased effectiveness and the decomposition of the pole consequently is materially hastened. Several years ago the Forest Service co-operated with one of the large telephone companies in Georgia and Florida to experiment with various preservatives in protecting the butts of telephone poles from decay. These preservatives were simply painted upon the wood, and of course did not sink in to any great depth. A recent examination made of this pole line showed that wherever the preservative had entered the wood no destruction due to insect attack had taken place, but where the wood was unprotected, such injury was frequently quite serious. Poles in which the preservatives had seeped through a crack were often more or less fluted on the surface, that is, the oil saturating the wood in the immediate vicinity of the crack protected it from the attacks of the insects. It is essential, therefore, particularly in the warmer portions of the United States, to protect timber from the attacks of insects as well as of fungi, if the longest life is to be secured.

PERSONAL.

W. H. Little, of Woodin & Little, San Francisco, is in the Yosemite Valley.

H. E. Lamar of the Golden West Plating Works, San Francisco, is traveling in Mexico.

H. J. White, manager Keeler, White & Co., manufacturers' agents, 824 Folsom street, San Francisco, is in Los Angeles.

Converse J. Smith, President Standard Gas Engine Company, Oakland, California, is making a trip through the Northwest.

H. L. Crocker and M. L. Ketchum have opened offices as consulting civil engineers at 811 Seventeenth Street, Denver, Colo.

C. G. DuBois, comptroller of the American Telephone & Telegraph Company of Boston, is expected in San Francisco about July 1st.

Wm. H. Hall, consulting engineer, Postal Telegraph Building, San Francisco, left for New York this week on professional business.

W. I. Otis of Otis & Squires, San Francisco, will return next week from an extended trip of several weeks through Southern California.

S. T. Johnson, contracting engineer and manufacturer of oil-burning apparatus, 1334 Mission street, San Francisco, is in Honolulu and will return in about two months.

C. E. Glafke, of the Glafke Manufacturing Company, 151 Minna street, manufacturers of valves and pump governors, was among the California boosters at Seattle this week.

C. C. Hillis of the Electric Appliance Company of San Francisco has been in the East for the past three or four weeks and is expected back shortly after the first of July.

L. E. Sperry, former manager of the California Electrical Works and Western Electric Company at San Francisco, is now manager of the Omaha house of the Western Electric Company.

Frank W. Frueauff, vice-president and general manager of the Denver Consolidated Electric Company of Denver, Colorado, has been elected president of the National Electric Light Association.

John H. Dale of the Dale Company, New York, who has been seriously ill with pneumonia, has so far recovered that he is able to leave for a short trip to the seashore, where he is now recuperating.

J. F. Hetty, of Hetty Bros., San Francisco, who left on a trip abroad in April, was last heard from at Monte Carlo. His present plans are to reach San Francisco again on about the first of September.

A. S. McAllister, associate editor of the "Electrical World," New York City, is making a study of Western transmission practice. He was in San Francisco last week and is now visiting the Northwest.

James Campbell, well known in San Francisco in connection with electrical construction work is planning a trip of two years abroad. Arrangements made provide for his departure during May of next year.

W. S. Heger, assistant to the president of the Allis-Chalmers Company, who has spent the past three months on the Pacific Coast, returned to Milwaukee, Wis., on June [illegible]th, accompanied by R. B. Elder of the San Francisco office.

D. F. P[illegible]son, traveling auditor with the American Telephone & Telegraph Company of Boston, formerly connected with the Western Electric Company in the same capacity, is now in San Francisco and will spend several weeks in this territory.

H. C. Thaxter, sales engineer with the San Francisco office of the Allis-Chalmers Company, has returned from an Eastern trip of a month which included some time spent at the West Allis, Wisconsin, works of the company, familiarizing himself with details of manufacture.

G. B. McLean recently associated with the San Francisco office of Chas. C. Moore & Company, joined the San Francisco force of the Allis-Chalmers Company under date of June 15th as sales engineer. Mr. McLean brings with him a wide experience which includes four years of engineering work in Southern California with R. S. Masson of Los Angeles.

Richard W. Boren, who for a year and a half has been the expert ad compositor and trade-paper man on the instruction staff of the International Correspondence School of Advertising, at Scranton, has been engaged by the General Electric Company for special advertising work. It is understood that the General Electric Company will undertake some advertising on behalf of such specialties as electric irons, cigar lighters, etc.

TRADE CATALOGUES.

J. M. Regal Roofing and Keystone Hair Insulator, two articles of use to constructing engineers, are described in leaflets issued by H. W. Johns-Manville Co.

Archbold-Brady Co., engineers and contractors, Syracuse, New York, send a number of excellent half-tone illustrations of catenary railway and high voltage contsruction of their design.

An International Achievement is the subject of an illustrated pamphlet from the Western Electric Company, describing the rapid reconstruction of the Paris telephone system destroyed by fire last year.

Gasoline driven locomotives for service manufacturing plants, mills, lumber yards and camps, mines, plantations, quarries, railroad, electric railway, tunnel and canal construction and general freight and passenger transportation are attractively portrayed in Publication No. 100 from the Milwaukee Locomotive Manufacturing Co., Milwaukee, Wis.

The American Electrical Heater Company, Detroit, Mich., is drawing attention to the "American" instrument sterilizer in a handsomely printed brochure to the trade. The sterilizer is made entirely of aluminum. The body is cast in one piece, consequently there are no seams to come apart. There is no danger of leaking, in fact, trouble of any kind. Not only this, but the aluminum retains its finish and is always sanitary, clean and neat in appearance. Most sterilizers are flimsily constructed of sheet metal with soldered seams. It is equipped complete with aluminum instrument tray, cover, etc.; made for three different heats, the maximum to heat the water quickly, the minimum—one-fourth of the maximum—being sufficient to keep the water boiling.

PORTLAND SECTION, A. I. E. E.

At a meeting held in the Sherlock Building, June 1st, the organization of a Portland Section of the American Institute of Electrical Engineers was effected and the following officers were elected for the ensuing year: Chairman, O. B. Coldwell; Secretary-Treasurer, L. B. Cramer; Executive Committee, W. Spalding, L. M. Antoine and L. Quimby. After the business meeting a smoker was held. Entertainment was provided and refreshments were served. The evening was much enjoyed by all. The attendance was thirty-five.

INDUSTRIAL

NEW POLICE COMMUNICATING SYSTEM.

Absolute municipal police protection is economically provided by the patrol flashlight system. The complete outfit provides absolutely reliable means of instantly reaching any patrolman on du y, as well as the equipment for communica'ing with headquarters from any patrol district. Separate apparatus furnishes a modern fire alarm system as well as

Fig. 1. Closed Patrol Box.

ins'ant means for calling a patrol wagon, and a device for registering the officers' report calls on a tape at police headquarters. The system is by no means in the experimental state, since a complete installa'ion has been in successful operation in North Tonowanda, N. Y., for the past two years. Heretofore, there has been no system to call the patrolmen from headquarters, unless the officer happened to be near enough to her his bell ringing.

In installation, patrol boxes are so loca'ed on each district that at least one light is always within the line of vision of the officer on that beat. If headquarters desires to reach any patrolman, all of the lamps in his district may be lighted to advise him to come to the telephone. The telephone part of the equipment is perfect. By connection through the most modern multiple circuits, all possibilities of noisy lines or other interruptions are completely removed. An interesting test in demonstrating the apparatus is to show that the tick of an ordinary watch is readily heard over the lines.

The flashlight patrol box also provides instantaneous fire alarm facilities, which may be included in the initial installa'ion or readily added at a later time. The apparatus is so simple in construction that this change may be made in a very few minutes by the addition of a few small parts. Turning in an alarm automatically lights a lamp calling the patrolman in that district. This stays lighted until the fire chief replaces the glass which has been broken to obtain the key. Police headquarters as well as the fire department are notified automatically.

The illustrations show the details of the patrol box. Fig. 1 shows the general appearance of the closed box as it would be mounted. Fig. 2 shows that portion of the box that is exposed in making a report to headquarters or in turning in a fire alarm. The hook on the right has a dual purpose in providing facilities for police regulation and for the ordinary fire alarm purposes. The Dean indestructible transmitter and receiver are shown in this illustration, as well as a small button immediately above the receiver. This button is used for calling the patrol wagon.

Fig. 3. Illustrates the inner mechanism exposed by opening the second door. The position of the lamp, lightning ar-

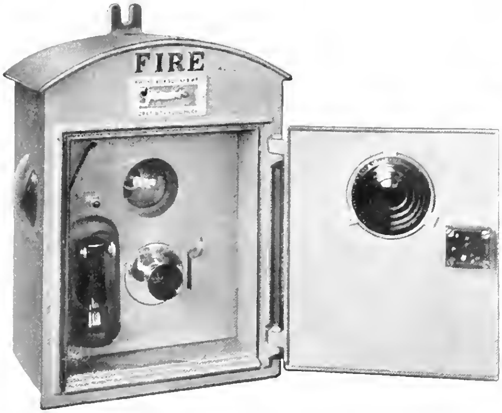

Fig. 2. Open Patrol Box.

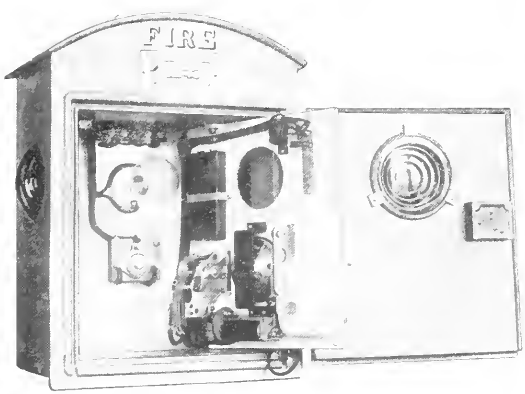

Fig. 3. Inner Mechanism of Box.

This outfit was installed by R. Max Eaton, the general manager of the Niagara Home Telephone Company.

The distinctive feature of the flashlight system is the addition of three powerful red lenses in the patrol boxes. A brilliant incandescent lamp may be lighted behind these lenses by the operation of a very simple connective device at police headquarters. The lights are visible from three directions for at least 500 yards in the day time and for miles at night. rester, line terminal posts, etc., are very clearly shown. All of the apparatus is very readily accessible and all contacts are plainly exposed for examination.

The entire outfit is mois'ure proof, and by the use of special prepared wire, difficulties from this source are eliminated. To prevent even the slightest interruption of service, the standard Dean indestructible parts are used almost exclusively. Very little special apparatus is required. Hence, operating

companies may maintain a patrol flashlight system without encountering the necessity of carrying an additional line of spare parts.

The economic saving of this method is evident, since the telephone company already has cables all over the city. Their trained technical men build and maintain the system in satisfactory operation at a much less cost than the city could handle the work. The saving in outside construction alone is enormous.

RAILROAD MEN AT A. Y. P. EXPOSITION.

Chas. S. Fee, passenger traffic manager of the Southern Pacific Company, has telegraphed that twenty Southern Pacific passenger agents from all parts of the Pacific System visited the Alaska-Yukon-Pacific Exposition on June 9 and were unanimous in their praises of all that they saw. It's a wonder, unique among all similar expositions. It tells a big story to people of all this nation, a true story of what there is to be found today in Alaska and the great Northwest. Every building was ready on the opening day and flags flying and bands playing just as they will continue until the closing October 15th. The exposition as it stands represents an investment of about ten million dollars. The Forestry Building, made of monster timber from the forests of Washington, is the most remarkable of all buildings, while the Alaska exhibit tells in detail of the country that has yielded two hundred and ninety-six million dollars worth of products in the past thirty years. The buildings and grounds are remarkably well arranged, so that one can get about easily without weariness and all details most artistic in conception.

SAN FRANCISCO AUXILIARY FIRE FIGHTING SYSTEM.

Considerable interest has been manifested in the auxiliary fire system that is now being constructed in San Francisco and while at this time there is not sufficient data available for a complete report covering the behavior of these pumps during tests, it can be stated that the first part of the contract that the Byron Jackson Iron Works had with the City of San Francisco is complete, the pumps having been delivered and accepted and the workmanship, guarantee of economy, pressure and capacity up to the expectations of the engineers. The contract consists of four units of 600 h. p. each, driven by Curtis steam turbines, these units having a capacity of 2250 gallons per minute, against a pressure of 300 pounds, and so arranged that by a manipulation of valves a capacity of 4500 gallons per minute may be obtained under a reduced pressure of 150 pounds.

The second part of the contract consists of eight four-stage station pumps, to be placed in two pumping stations that are now being designed, and which are to be located near the waterfront. These pumps each have a capacity of 2700 gallons per minute against a pressure of 300 pounds, being driven by 750 h. p. Curtis steam turbines.

NELSON CRUDE OIL BURNER.

The Nelson crude oil burner is the only burner that does not require an oil pump or other auxiliaries for its successful operation. In the Nelson system the oil is not under pressure and when the burner is not in operation the oil in the system automatically returns to the oil storage tank. The oil passages through the burner are large and free from obstructions, therefore the burner will not clog or fill with carbon, and the Nelson burner is guaranteed to more thoroughly atomize the oil passing through the burner than is possible with any burner using baffles, small openings or screens for atomizing purposes.

[illegible] inside working parts and there is nothing [illegible] will need attention or repairs after [illegible] Beggs & Weld Company, 507 Mission Street, San Francisco.

LOW PRESSURE TURBINE IN THE LUMBER INDUSTRY.

That the economies possible in the use of low pressure turbines are not confined to the highly efficient power plants of the East, is apparent in the contract recently placed by the Potlatch Lumber Company for a 600 kilowatt Westinghouse exhaust steam turbine to be installed in the company's central power plant at Potlatch, Idaho. There are at present located in this plant one rope-driven Corliss engine and a 100 kilowatt high-speed triple engine driving a generator. The low pressure turbine will take steam at about 15 pounds absolute from both of these units, and some other auxiliaries generating power for the operation of a new planing mill and box factory. Arrangements have also been made for the operation of this unit for lighting for the mill and the surrounding town. The equipment ordered also includes a Westinghouse Leblanc condenser designed for carrying a 28-inch vacuum. At the Potlatch plant, refuse from the sawmill is used entirely for fuel at practically no cost, this being burned under M. R. T. boilers.

It is thus apparent that the capacity of the plant has been very greatly increased with practically no cost except the charges on the low pressure turbine installation. This feature of exhaust turbine work, is being rapidly appreciated by managers of power plants in every line of industry, resulting in a number of orders for equipments of this character. Just recently the Westinghouse Company has installed low pressure turbine equipments in the plant of the Pressed Steel Car Company, Pittsburg, and the American Iron & Steel Company, Lebanon, Pa.

BENJAMIN WEATHERPROOF TUNGSTEN ARC.

The "Benjamin Weatherproof Tungsten Arc Lamp," manufactured by the Benjamin Electric Manufacturing Company, Chicago, Ill., is a good-appearing and efficient substitute for arc lamps. It has a twenty-inch high-grade porcelain-enameled steel reflector and a twelve-inch glass ball. Above the former is the body portion of copper, a metal cross-arm with porcelain knobs, a weatherproof porcelain connecting block, and a suspension loop. The globe may be suspended and held in position for cleaning and removing the lamps, or may be entirely removed, if desired. This is accomplished by means of a rod passing through the hollow support. It is ventilated

at the top and the bottom by holes which are small enough to keep out insects. An inside reflector of white enameled steel, with openings for the lamps, assists in the radiation of light. This and the main reflector are low enough to secure a good distribution of the horizontal rays in a downward direction. The device may be furnished without the upper portion when attached to a gooseneck or other form of suspension where the wires are concealed. It is made with four and five lights and is suitable for lamps with a maximum wattage of 100. The above illustration of the Benjamin Weatherproof Tungsten Arc shows the compactness of this fixture as compared with the usual arc lamp, which it greatly resembles in external appearance, except that it is much shorter.

THE MECHANICS FAIR.

The Mechanics' Fair, given under the auspices of the National Association of Stationary Engineers and in connection with the Sixth Annual Convention of the California section of that order was held during the present week at the Auditorium, San Francisco.

From every standpoint the Fair was an unqualified success; the attendance was large during the entire week, particularly during the evenings. The exhibit was a representative one, including machinery and accessories of every description, a large part of it being in actual operation. Attractive decorations and an unusually good band concert, afternoon and evening, developed a carnival spirit which was irresistible.

The various committees and managers who worked long and tirelessly to bring about this result are entitled to congratulations for the successful manner in which their plans were carried to completion; the numerous exhibitors also are entitled to great credit for the liberality shown in their displays and the enthusiasm with which they supplemented the work of the Association.

It was unfortunate that that feature of the program which called for the introduction of the National President, Fred J. Fischer, could not be carried out owing to his non-arrival at the expected time. When this point in the program was reached it was announced that Mr. Fischer was lost in the fog on the steamer Santa Rosa.

In the absence of the National President, State President Harry D. Saville made the address of welcome on behalf of the Association, outlining its objects, reviewing its past history and expressing its hopes for the future. After an impressive prayer by the Rev. Wm. Rader, P. L. Ennor, Chairman of the Convention Committee, introduced Mayor Edward R. Taylor, who, on behalf of the City of San Francisco, extended a warm welcome to the visiting engineers and in a few brief words commented on the science of steam engineering and the important position it occupies in industry.

At the conclusion of his remarks the button was pressed which gave the signal for the opening, the band played the Star Spangled Banner, bells rang, whistles blew, machinery roared, and, aided by the cheers of the spectators, the Mechanics' Fair of '09 was formally under way.

In view of the numerous exhibitors it is impossible for the Journal to include a complete description of the various exhibits in this issue and a description of a part is given below; the description of the balance, together with the complete proceedings of the Convention itself, will appear in our issue of June 26th.

Exhibit of General Electric Co.


Exhibit of Westinghouse Electric & Manufacturing Co.

The exhibit of the GENERAL ELECTRIC COMPANY, in booths 119, 120, 181 and 182 attracted a great deal of attention and was crowded with interested visitors during the entire week. It was planned by A. G. Jones and H. E. Duren of their San Francisco office who were assisted during the week by F. E. Vickers, A. Strauch, E. O. Shreve, J. S. Baker and G. E. Rutledge. A searchlight, flaming arc lamps and a mercury arc rectifier were in continual operation, and the exhibit also included fan motors, power motors of different types and some typical examples of their heating and cooking devices. A 35 k. w. 3600 r. p. m. non-condensing Curtis turbine attracted a great deal of attention.

THE WESTINGHOUSE ELECTRIC & MANUFACTURING COMPANY, Second and Natoma Streets, San Francisco, occupied booths 116 and 117. The Westinghouse exhibit was a diversified and interesting one both for the electrician and layman. A complete line of electric irons, luminous radiators, hot plates and other heating devices, together with a motor-driven washing machine and a sewing machine interested the women, while a small steam engine operated by compressed air and a single phase motor operating an air compressor interested the mechanic. The exhibit was lighted by a large Westinghouse electric sign illuminated by a 27-volt, 10-watt tungsten lamps, the voltage being reduced by tungsten economy coils on the switchboard.

This exhibit was in charge of J. E. Collins, C. D. Herbert and J. G. de Remer.

THE WESTINGHOUSE AIR BRAKE COMPANY, Pacific Building, San Francisco, occupied booths 118 and 183 and was in charge of A. F. Peterson, manager of the San Francisco office. It included belted compressors, direct connected motor compressors, direct connected steam driven compressors and accessories.

Exhibit of Western Electric Co.

THE WESTERN ELECTRIC COMPANY was located in booths 136, 164. Their exhibit included a complete line of fan motors, forge blowers, arc lamps, Sunbeam tungsten lamps, Blue Bell dry batteries and a complete system of their most recent types of intercommunicating telephones in full operation. The exhibit was in charge of F. C. Todt and E. K. Dyer devoted some of his time during busy moments.

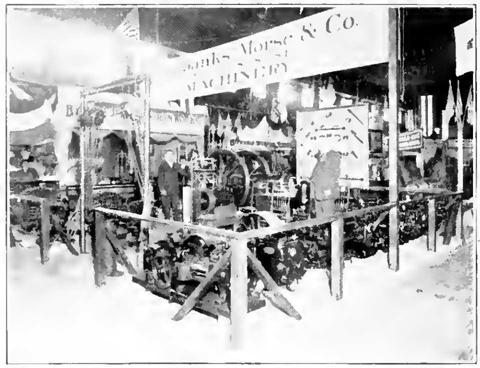

Exhibit of Fairbanks, Morse & Co.

FAIRBANKS, MORSE & CO., 158-162 First Street, San Francisco, occupied booths 198, 199, 200, 257, 256, 258, in charge of D. C. Martin C. F. Reuter, L. E. Penniman, P. F. Wood and E. V. Sheppard. Their exhibit was an elaborate one, the principal features consisting of duplex steam pumps, duplex power pumps electrically driven, alternating and direct current motors, and horizontal and marine gasoline engines.

Exhibit of Eccles & Smith Co.

In the central booth THE ECCLES & SMITH COMPANY exhibited Chicago pneumatic tools and air compressors, the manner of handling these tools and the work they will accomplish, was shown by the demonstrator. An artistic arrangement was made of Albany grease, mechanical rubber goods, Majestic boiler compound and engineroom supplies in general. Especial mention should be made of the Dean boiler tube cleaner. The manner in which it removed the scale from a fire tube during the demonstrations was noted particularly. The ladies fell in love with the Thor electric washing machine. The Eccles & Smith Company show this machine as an introduction to the public of a complete line of household appliances operated by electricity, which they will offer in the near future. The public generally is invited to the sample rooms, 71 First Street.

As to the care of tungsten lamps, the General Electric Company in one of their recent bulletins suggest that a wall switch, instead of one at the socket will prevent jarring the filament when cold—its least durable state. When wiping or dusting the bulb, shade or fixture, the lamp should be burning.

Exhibit of Maryland Casualty Co.

THE MARYLAND CASUALTY COMPANY, whose home office is in Baltimore, Maryland, was represented during the entire week in an attractive booth in charge of C. M. Hansen, the inspector general of the company, assisted by W. B. Wentz and H. W. Wheatley. The object which this company had in co-operating with the Mechanics' Fair was to advise owners and operators regarding the details of their business, and particularly that their form of insurance furnishes educated and trained inspection service; also to advise how to avoid accidents. Literature distributed by them treated on the strength of rivets, science of inspection and other features of interest. In connection with their service they emphasized their claim that the basis of boiler insurance is intelligent inspection.

NEWS OF THE STATIONARY ENGINEERS.

San Francisco No. 1, N. A. S. E., held a smoker and housewarming at their new hall, 124 Fulton street, on the evening of June 10th.

The occasion was also given in honor of the sixty-first birthday of Bro. Conrad Witzel, the only remaining charter member of the organization.

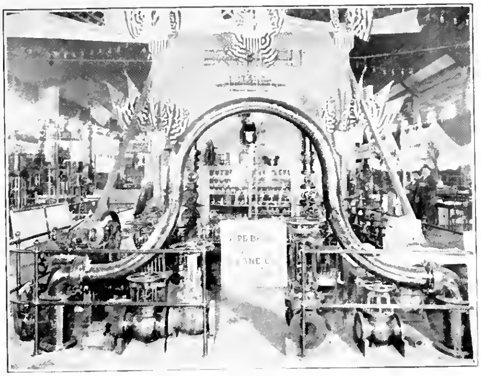

Exhibit of the Crane Co.

CRANE CO.'S exhibit consisted of a display of valves and fittings ranging in size from ⅛-inch to 18-inch. A novel feature of their display was the 4-inch, 6-inch and 8-inch pipe bends made in elbow and U patterns in their San Francisco shops. Their all steel valves for superheated steam were also prominently displayed. The exhibit was in charge of Mr. Milton G. Moenning.

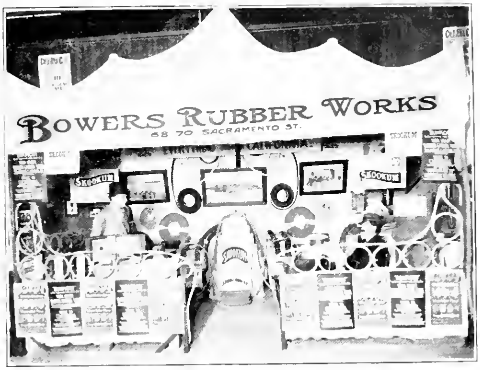

Exhibit of Bowers Rubber Works.

One of the most attractive features of the fair was the display of the BOWERS RUBBER WORKS, San Francisco. The exhibit gives a general idea of their line of rubber goods, all of which are manufactured in California. Their factory is the first and largest on the Pacific Coast importing crude India rubber and manufacturing it into all kinds of mechanical rubber goods such as belting, hose, packing, mats and molded goods. The exhibit was in charge of John M. Powell and H. R. Mansfield.

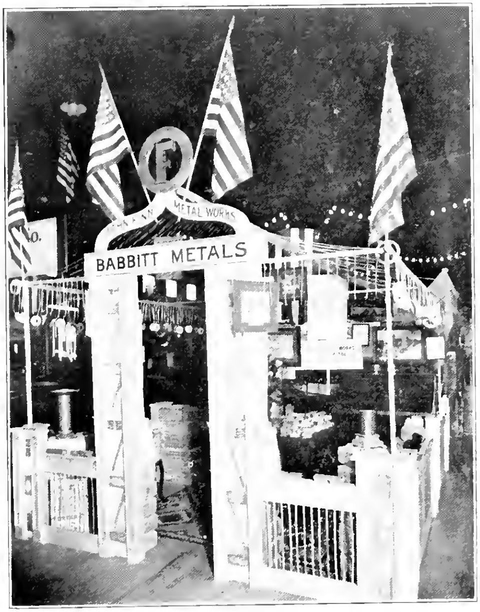

Exhibit of John Finn Metal Works.

JOHN FINN METAL WORKS of 384 Second Street, San Francisco, occupied booths 125 and 176 where they gave a complete exhibit of Babbitt metal, solder and galvanized work. For over twenty year. this company has made its headquarters in San Francisco, manufacturing high grade Babbitt metal and solder for every purpose. This company manufacures twenty-four grades of Babbitt metal and it has always been their policy to educate the machinery and engine manufacturers in the proper grade of metal to use in order that the purchaser may secure the greatest advantage. This company maintains a force of experts who are always ready to furnish information pertaining to the grade of metal required for any service.

Exhibit of Staples & Pfeiffer.

STAPLES & PFIEFFER of 102 Steuart Street, San Francisco, were in booths 112 and 113 which were in charge of Messrs. Staples and Pfieffer, assisted by F. Hoffman. They exhibited the S. & P. self cleaning oil burners, self cleaning oil systems, self cleaning oil strainers, self cleaning relief valve. Their claims of being "up to date and a day ahead" and "no fuss—no worry—no delay—no trouble" attracted numerous engineers and their booth was crowded continually. They distributed many copies of their books on "Oil-Burners and Oil-Burning Pointers."

EXPOSITION NOTES.

F. H. Doyle, 712 Market St., San Francisco, was the official photographer and furnished all pictures of exhibits.

The searchlight in the exhibit of the General Electric Company was in the hands of an operator with a keen appreciation of stage effects. It was turned on by His Honor Mayor Taylor at the critical moment when pushing the button which opened the fair and later illuminated the smiling face of National President Fischer during his introduction from the balcony.

NEWS NOTES

TELEPHONE AND TELEGRAPH.

BOTHELL, WASH.—The Independent Telephone Company will erect a building for a sub-station.

SAN FRANCISCO, CAL.—A new wireless plant is being installed in the Pacific Coast Company's liner President. A special room has been built on the after hurricane deck, in which the United Wireless Telegraph Company has placed a two-kilowatt plant to take the place of the former system.

SAN FRANCISCO, CAL.—With the idea of increasing the power of the wireless station on the Farallon Islands so that a conversation can be had at least 1,000 miles farther away than at the present time, a party headed by George Hanscom, master electrician of the Mare Island navy yard is at the islands. It is the idea of the navy department to rebuild entirely the wireless tower and to install a number of new instruments. This work is expected to require about one month to complete. When finished the tower will, it is asserted, have the highest power plant in the service of the government.

INCORPORATIONS.

FRESNO, CAL.—Waratah Oil Company; capital stock $300,000; by the above named as directors.

BAKERSFIELD, CAL.—Kern Four Oil Company; capital stock $100,000; by H. F. Brown, H. P. Taylor, L. R. Works, J. D. Works and A. M. Williams.

ANAHEIM, CAL.—Security Oil Syndicate; capital stock $240,000; by J. E. McDonald, H. P. Caotes, K. A. Snyder, J. B. Merrill, and I. L. Gates, all of Los Angeles.

CORNING, CAL.—Beacon Oil and Gas Company; capital stock $200,000; by Charles Hughes, C. L. Cofer, J. B. Reese and W. A. Fish of Red Bluff and H. M. Owens of San Francisco.

FRESNO, CAL.—Minoru Oil Company; capital stock $500,000, by A. L. Weil, M. Syme, Jessee Mueller and William E. Eckhoff of San Francisco and E. B. Davis of Oakland. Place of business, San Francisco.

SALT LAKE CITY, UTAH.—The Progressive Telephone Company of Lincoln, Tooele County, has filed articles of incorporation with the secretary of state. The Capital is $3500. The incorporators are ten residents of Lincoln. J. W. Whitehouse, president; Harriet W. Sagers, vice-president; Charles Hansen, secretary, and others.

BAKERSFIELD, CAL.—Articles of incorporation for the Producers' Transportation Company which will handle the oil of the independent producers of Kern County and Coalinga have been filed here. The company is capitalized for $7,000,000 and the directors are: L. P. St. Clair, S. W. Morshead, W. W. Welsh, M. V. McQuigg, Thomas O'Donnell, L. W. Andrews and W. B. Robb. Bakersfield is the principal place of business. The Union Oil Company is reported to be financing the corporation.

NEVADA CITY, CAL.—Articles of incorporation of the Middle Yuba Hidro-Electric Power Company have been filed here. The principal place of business is to be Nevada City and its capital stock is $400,000. The directors named are: A. D. Foote, C. M. Wilson, W. H. Martin, L. M. Hancock, L. N. Wagner, C. T. Jones and Dr. A. H. Tickell. They are all local men and will build an electric power plant on the Middle Yuba river above Graniteville to supply power to the mines of that district, Alleghany and other Nevada and Sierra county mining towns.

TRANSMISION.

HANFORD, WASH.—The Hanford Irrigation and Power Company has let a contract to the Allis-Chalmers Company for machinery for an electric sub-station and waterworks in Hanford. Electric current is to be brought down from Priest Rapids to Hanford to operate a pump with a capacity of 750,000 gallons a day.

WALLA WALLA, WASH.—Plans for a new $100,000 power plant and sub-station and for a $30,000 office building and depot has been announced by officers of the Northwest Corporation, the holding company for the local electric light company and the Walla Walla Valley Traction Company, work to commence at once.

YREKA, CAL.—Harvey J. Sarter and assistants have completed the survey of the Siskiyou Electric Light and Power Company's new power line from the Fall Creek power house as far as Sisson. Up to this point the route follows the township lines and is perfectly straight. Where the line passes Sisson a branch will be run west to the town. At the point of intersection the main line diverges to the east and will follow the county road into Dunsmuir. The survey, which is about 55 miles long, will be completed in a few weeks. It runs through the Big Springs country and will furnish power to pump water and irrigate thousands of acres of dry land. The company is extending the south end of the Fall Creek powerhouse to accommodate another 1000-k. w. generator. The new line will be equipped with heavy copper wire. The poles, wire and insulators are now at Ager, Montague, Weed and Sisson ready for distribution along the line. The construction crew will work south from Fall Creek, following up the surveying crew. The various lines of the company will be tied together as fast as completed in order that power may be pumped from one line to another in case of accident at any point.

FINANCIAL

MONROVIA, CAL.—This place has voted $16,500 in bonds for waterworks improvements.

HOOD RIVER, ORE.—An election will be held July 28 to vote on the question of issuing bonds in the sum of $90,000 for a municipal water system.

JACKSONVILLE, ORE.—The people of Jacksonville will this week vote upon a bond issue of $100,000 for the construction of water works for the city.

CENTRAL POINT, ORE.—The City Council has taken initial steps toward issuing bonds to the amount of $25,000 for the installation of waterworks.

HILTON, ORE.—The election held May 25 resulted in a large majority favoring the issuing of bonds to the amount of $15,000 for the extension of the city light and power plant.

ILLUMINATION.

FRIDAY HARBOR, WASH.—The Pacific Electric Company of Port Townsend, has applied to the city council for a fifty-year franchise to furnish electric lights for Friday Harbor.

SANTA ANA, CAL.—Application has been made to the Supervisors for a 25-year franchise for a transmission and distributing system for light, heat and power purposes. Sealed bids will be received by the Board of Supervisors up to July 7th.

KENDRICK, IDAHO.—A franchise has been granted to the Kendrick Gas Company to furnish gas to residents of the town.

PULLMAN, WASH.—The Trustees of the State College are considering $50,600 expenditure on the lighting and heating plant.

NATIONAL CITY, CAL.—The City Trustees are figuring on two separate schemes for increasing the efficiency of street lights in National City.

BELLINGHAM, WASH.—The Washington Mining & Development Company will spend $200,000 in erecting a power station on Collins Creek. W. N. Bath is director.

SAN DIEGO, CAL.—The City Council has awarded a contract for furnishing ornamental iron posts, eight in number, for Fifth street, from B to C, to the Standard Iron Works, their bid being $725.22.

SAN DIEGO, CAL.—The San Diego Consolidated Gas & Electric Company has increased its capital from $1,500,000 to $3,500,000; extensive improvements will be made to its plant. R. L. Clarke is superintendent.

SAN JOSE, CAL.—Sealed bids will be received by the Board of Supervisors up to July 12, 1909, for a franchise to construct underground conduits as applied for by the Los Gatos Ice, Gas & Electric Company.

LOMPOC, CAL.—The stockholders of the Lompoc Light and Power Company met this week and elected directors and transacted other business matters of importance. It was decided to replace the engine with one of double efficiency or about 150 horsepower. Mr. Heller was re-elected president; Mr. Baird, vice-president and T. F. Fox, treasurer.

OAKLAND, CAL.—Work began June 14th on the new plant of the Oakland Light and Power Company at the corner of First and Alice streets. The company is capitalized at $1,250,000. The new power plant will be equipped with machinery sufficient to generate 25,000 horsepower, and it is expected the new plant will be in operation by January 1st.

SAN FRANCISCO, CAL.—A new electric, gas and power company, organized by Rudolph and Claus A. Spreckels has been incorporated under the name of the Municipal Light and Power Company. It is capitalized at $1,000,000, of which $500 has been subscribed, $100 by each of the five directors, who are Rudolph Spreckels, Claus A. Spreckels, Percival S. Scales, J. H. Sandford and Frank Harrold, clerks in the Spreckels office. An electric light plant known as the Spreckels plant has been in operation for some time on Jesse street near Third street, and recently has been enlarged. It has been supplying light to several of the Spreckels buildings, also to the Phelan building on Market street, and to adjacent hotels, and it is believed that this plant is the basis for the formation of the new company.

IMPERIAL, CAL.—W. F. Holt, who has been spending the week in Imperial Valley, says El Centro and Imperial will have domestic gas service simultaneously. He has ordered ten carloads of service pipe, five for Imperial and five for El Centro, and these are to be shipped at once from Pittsburg. Contracts for the entire gas-making plant have been awarded, and the machinery will soon begin to arrive in the valley. It is probable that the erection of the plant at El Centro will not be started until September 1st, as the summer heat is too great for best results from workmen who will come from the East to equip the plant. In the meantime material will be assembled and the concrete foundations will be laid, so that rapid progress may be made when the structural work is once started. Mr. Holt expects to be ready to serve gas to residents of El Centro and Imperial by December 1st. Later he will make arrangements to put in gas at Holtville, Brawley and Calexico.

TRANSPORTATION.

HALF MOON BAY, CAL.—L. Coburn of Pescadero is contemplating building a street railroad from Pescadero to Pebble Beach.

LA MESA, N. M.—A franchise has been granted to O. H. Bowen to construct and maintain a street car line between Las Cruces, Messilla Park and College.

ROCKFORD, WASH.—The people of this place have petitioned the Spokane & Inland Electric road to build its proposed line into the Coeur d'Alene Indian reservation through this town.

SACRAMENTO, CAL.—The blockade maintained by the Southern Pacific Company against the Northern Electric Railway Company at Front and R streets, and at Front and O streets, for two weeks has been raised. The Northern Electric may now build its crossings through and over the Front street lines of the Southern Pacific and there will be no derailed cars to retard progress. The officials of the Northern Electric Company have signed up a contract offered by the Southern Pacific Company officials, by means of which the latter road protects its rights and the former pays for the expense of making the crossings.

VALLEJO, CAL.—Captain Charles Hatch of the Monticello Steamship Company, President W. Botsford of the Vallejo and Napa Valley Electric road and Superintendent McIntyre have left for a visit through Lake County in an automobile to determine the best route for the extension of the local road into Lake County and also to try and secure a right of way for the proposed extension from St. Helena to Clear Lake. At present the electric road surveyors are laying out the lines for an extension of the road from St. Helena to a point in the vicinity of the Graystone winery, half a mile north of the city. This section of the road will be constructed immediately, as the rails and ties are already on the ground.

FRESNO, CAL.—The contracts have been signed by the Fresno, Hanford and Summit Lake Railway Company with an Eastern construction company. The contract calls for one million dollars, the amount to be paid out to put the road into operation and the actual grading of the road and laying of track must be started not later than July 15th of this year. In the contract it is provided that the interurban line must be in operation by April 1, 1910. As the preliminary survey work has been completed, all these engineers will do now will be to get the right of way ready for the ploughs, shovels and teams. As soon as the engineers have made a good start along this line, dirt will begin to fly and work will be rushed as fast as possible. The Franklin Construction Company, an Eastern firm, will have charge of the building of the road. The new line will be a standard gauge road and the rails will be of 75 pound steel.

SAN FRANCISCO, CAL.—According to a report from Fresno the lines of the Fresno Traction Company will be taken over by the Harriman interests. A. G. Wishon, the present manager of the street railway lines, is to be superseded by one of the Harriman officials, but his name has not been made public. Local officials of the traction company are still in the dark concerning the proposed change. Among those mentioned to succeed Wishon is Chief Clerk W. Durfy of the local office. Incidentally it has leaked out that a more distinct separation will hereafter exist between the Fresno Light and Power Company on one side and the street railway company on the other. The former is controlled by the Huntington

interests, while the latter is now owned and controlled by a private corporation having its headquarters in Los Angeles. A. G. Wishon is general manager for both companies. If the contemplated entry of the Harriman people takes place Wishon will likely assume charge of the light and power company for the Huntington interests. A. G. Wishon declares that there is absolutely no truth in the report.

OIL.

SANTA BARBARA, CAL.—Surveyors for the Associated Oil Company, who are fixing a route for the proposed pipe line from McKittrick to Gaviota have reached the west slope of Tepusque grade, and their work is nearly done.

HAINES, ORE.—D. M. Hunt of La Grande has secured the contract for boring a well 2,000 feet deep on the oil lands of the Eastern Oregon Oil and Gas Company, of St. Johns, Ore. Work will commence as soon as the machinery can be placed on the ground.

SANTA BARBARA, CAL.—The Rahn Consolidated Oil Company of Los Angeles, has begun operations on the Higgins place in Carpenteria. A standard rig has been erected by Chas. Bates of this city and three more rigs will be erected in a short time.

SAN FRANCISCO, CAL.—A steel oil-burning tank steamer for the Associated Oil Company for use in the trade out of this port, is under construction at the yards of the Newport News Shipbuilding Company. The vessel is to be finished within a year and will cost $750,000. The steamer will be 390 feet in length, 49 feet in breadth and 30 feet deep.

LEBANON, ORE.—C. W. Taylor, manager of the Cascade Petroleum Company, states that the location of the first well will be definitely decided this week. The company has determined to install a big California Standard rig instead of a Star machine, as first planned, and has placed an order for this with a Los Angeles house. The drillers and rig builders are now at Portland and will be here next week.

BAKERSFIELD, CAL.—The Union Refinery, in the Kern River fields, east of the Standard's tanks, is engaged in enlargement which will almost, if not quite, double the capacity of the plant, and make it the largest refinery in the county. One new 150 horsepower boiler is being installed, and five new stills. There are at present three boilers, of about 60 horsepower each, and six smaller stills. The work will be completed within a few weeks.

PORTLAND, ORE.—Good progress is being made in salvage operations on barge No. 91, owned by the Standard Oil Company, which went ashore near the mouth of the Columbia river several weeks ago. About 17,000 barrels of oil have been pumped from the vessel's tanks and the craft has been floated a distance of half a mile and beached. Sunday she was placed on an even keel and it is expected that she will be towed to Portland during the week for repairs.

MARICOPA, ARIZ.—The Le Blanc well out on the flat has resumed operations after a shut down caused by lack of boiler water. Connections have been made with the Union Oil Company's water well and operations will be pushed rapidly forward. The well is now 1420 feet deep, 7 5-8 inch casing being used at the present time. The Essex, nearby, has reached a depth of 1300 feet with a 10-inch casing. Both these wells are worked on the circulating system by Ben Howe, the superintendent.

BAKERSFIELD, CAL.—All arrangements have been perfected for the projected pipe line from Temblor to McKittrick, and H. B. Guthrey who is interested in the Temblor-McKittrick company, has left for the West Side to arrange for making the trenches for the pipe. All the rights of way have been secured, and the actual work of laying the line will have been begun before the end of June. The new line will be 31,000 feet long and will extend from section 30 at Temblor, across 30, 32, 43, and 11, to McKittrick, connecting with the Associated pipe line. The new line will be four inches in diameter and will have a capacity of about 6,000 barrels a day. It is believed that this line will care for the output of the field for the next two years. The Temblor McKittrick has eight producing wells on its property, the best of which does about 150 barrels a day. The pipe line will have an initial pumping station. Two tanks are to be built of 1,250 barrels capacity, and it is expected that the line will be carrying oil within the next 60 days. The first pipe will arrive on the ground by June 15th.

BAKERSFIELD, CAL.—President St. Clair of the Independent Oil Producers' Agency, says that the survey for the proposed independent pipe line has been completed from Coalinga to McKittrick and rights of way are now being secured for this portion of the route. The right of way for the line extending from Dudley to the Coast has been secured. The pipe has been purchased but not shipped. It will be eight inches in diameter, and will have an estimated capacity of 20,000 barrels per day. The incorporation papers of the pipe line company will be filed probably by the middle of the week.

WATERWORKS.

VENICE, CAL.—The Venice Water Company has let a contract for another 20,000 gallon water tank to the Pacific Tank Company.

PORTLAND, ORE.—Sealed bids are being received at the office of the Port of Portland, City Hall, for steel riveted pipe and special pieces.

SACRAMENTO, CAL.—A contract for furnishing forty dozen water taps has been awarded to the Miller-Enwright Company for $912.

SAN RAFAEL, CAL.—The Board of Supervisors have received from F. Crooker of San Anselmo an application to operate a private water company in Deer Park.

TOPPENISH, WASH.—A special election will be held this week to vote on the question of issuing bonds in the sum of $24,500 for the purpose of installing water and sewer systems for the town.

LEAVENWORTH, WASH.—Permission has been granted to the Tumwater Light & Water Company to use Thirteenth and Commercial streets to the river for the purpose of laying water mains and erecting a pole line therein.

TACOMA, WASH.—The City Council has passed an ordinance providing for the laying of eight, six and sixteen-inch water mains, together with necessary gates, tees, crosses, etc., in certain streets of improvement district 541.

REDLANDS, CAL.—Work will begin in a few days upon a new pipe line for the Redlands Heights Water Company to run from the west end of the Crafton pipe line to the junction of the Heights line with the South Mountain.

SAN FRANCISCO, CAL.—At a meeting of the Board of Public Works this week bids were received for supplying 1200 hydrants to be used in the auxiliary fire system. The lowest was that of the Union Iron Works, at $119.74 each. The next lowest bid was the Risdon Iron Works, at $198.50.

OAKLAND, CAL.—Bids for the construction of a pipe line on the Beck road in Livermore road district, were as follows: L. L. Page, $4945; David McDonald, $5790; H. Gould, $5698.35. The contract was awarded to H. Gould who was allowed 45 days in which to make the improvements.

SAN DIEGO, CAL.—The Southern California Company was yesterday morning empowered by the common council to furnish material for and construct and lay a water main of 6-inch cast-iron water pipe from the present city main westerly to and through Newport avenue in Ocean Beach.

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public — the consumer — who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

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Lamp Adapters

American Ever Ready Co.
Benjamin Electric Mfg. Co.
Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Perkins Elec. SwtchMfg.Co.

ALARMS.

Burglar Alarms

Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc.
Western Electric Co.

Fire Alarms

Edwards & Co.
Partrick,Carter&WilkinsCo.
Western Electric Co.

Water Alarms

Partrick,Carter&WilkinsCo.

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Telephone & Elec.Equip.Co. "Holtzer-Cabot & Co."
Western Electric Co.

ARMS.

Cross Arms

American Cross Arm Co. "Walworth & Neville."
California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

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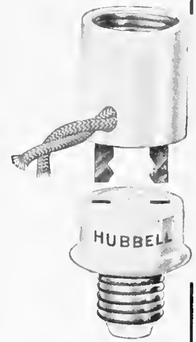

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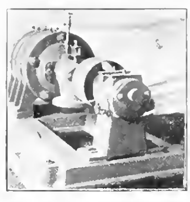

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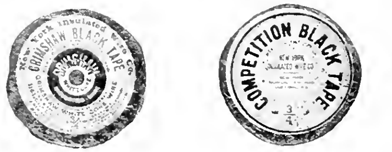

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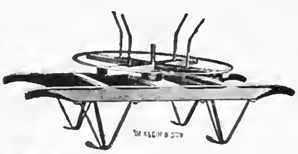

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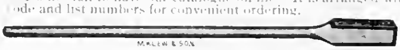

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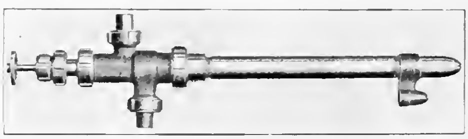

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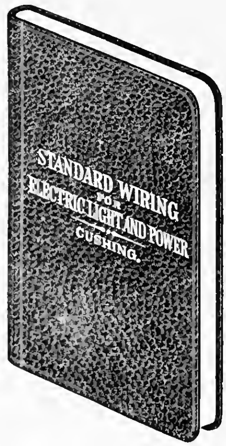

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Sunbeam Inc. Lamp Co., "Sunbeam."
Western Electric Co., "Sunbeam."

Tungsten Lamps
Brooks-Follis Elec. Corp., "Fostoria."
Bryan-Marsh Co., "Imperial."
California Inc. Lamp Co., "California."
Elec. Appliance Co., "Packard."
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Excelsior."
Sterling Elec. Co., "Sterling."
Sunbeam Inc. Lamp Co., "Sunbeam."
Western Electric Co., "Sunbeam."
Westghse Elec. & Mfg. Co.

LINE MATERIAL.

Street Ry. Line Material
General Electric Co.
Johns-Manville Co., H. W., "J-M."
Kierulff, B. F., Jr. & Co., "Lord Electric Co."
Pierson, Roeding & Co., "Ohio Brass Co."
Western Elec. Co., "Electrose."
Westghse Elec. & Mfg. Co.

MACHINES

Refrigerating Machines
Vulcan Iron Works

MINING

Mining Machinery
General Electric Co.
Henshaw, Bulkley & Co.
Moore & Co., Chas. C.
Westghse Elec. & Mfg. Co.
Western Electric Co.

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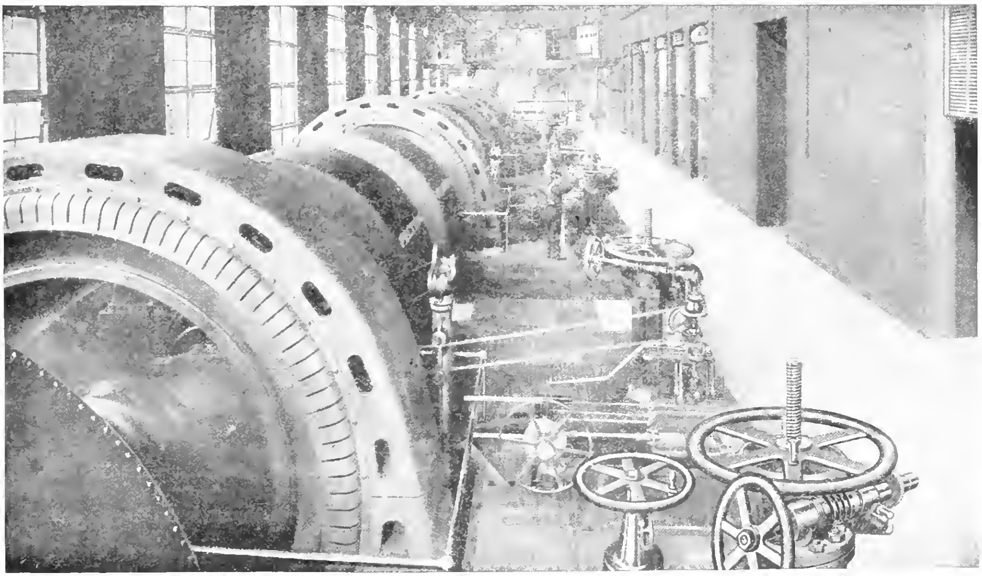
TURBINE PERFORMANCE WITH REFERENCE TO THE INFLUENCE OF CONDUIT FRICTION LOSS.[1]

BY J. R. JORGENSEN.

For any given water power proposition the static head is found by surveying the country. In order to be able to design the prime mover properly the effective head is especially wanted. This is found by calculation after the size and kind of conduit has been decided upon. For a certain case the friction loss in a 40,000 ft., 6 feet inside diameter, reinforced concrete flow pipe, provided with regulating reservoir and the connecting 4800 ft. pressure pipe, was found to be $55.3 + 7.5 = 62.8$ feet, when carrying water in sufficient quantity to develop normal load.



Pelton Water Wheels at Electron Plant of the Puget Sound Power Company.

The static head for this given case is 1104 feet and the effective head, therefore, $1104 - 62.8 = 1041.2$ feet. For a static head of 1104 feet only impulse wheels could be considered as prime movers. Reaction turbines for this head would not be practical in units of less than say 20,000 k. w. output, which at the present time would be too large for any ordinary station. However, for performance comparison we can make use of the reaction turbine for this head just as well as for half the head under which the two types would be competitors. The influence of a variable head is the greatest for the impulse type of wheels and will be considered first.

Fig. 1 shows a diagram of a 5500 k. w. tangential waterwheel, 360 r. p. m. The spouting velocity due to the effective head 1041.2 feet.

$$v = \sqrt{2g \times 1041.2} = 259 \text{ ft.}$$

The speed of the pitch circle is taken at 46 per cent of the spouting velocity, then

Dia. pitch circle from $\frac{360}{60}\pi d = 259 \times \frac{46}{100}$, $d = 6.32$ ft.

[1] Paper read before San Francisco Section A. I. E. E., May 28, 1909.

Extreme outside diameter of wheel 7.57 feet. Velocity $\frac{360}{60}\pi \times 7.57 = 142.79$ ft. per sec.

While turning 5 degrees the outer edge of bucket travels from point 0 to point 1.

$$\frac{\pi \times 7.57 \times 12}{360 \div 5} = 3.96 \text{ ft.}$$

This is done in the time

$$\frac{1}{360 \div 60 \times 360 \div 5} = \frac{1}{432} \text{ sec.}$$

In the same time the jet has traveled $\frac{1}{432} \times 259 \times 12 = 7.2$ inches = distance 1—in Fig. 1.

The distance 2-2 is just twice distance 1-1 for 0-2 equal to 10 degrees. In this way enough points are found to determine curve 0-1-2-3-17, and from this curve the portion of the jet striking one bucket is found.

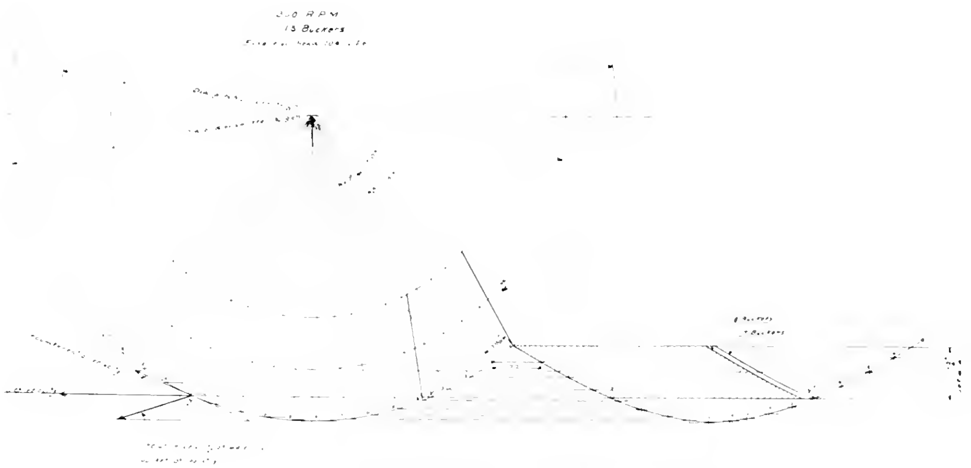


Fig. 1. Diagram of 5500 k. w. Tangential Water Wheel.

In point x the lip of the bucket is just through the jet, and from here to position y it receives the full impulse. When the bucket in question (let us call it No. 1) arrives at y, the bucket just back of it (No. 2) must have cut off all the water a certain time element before, long enough to give the last water particle cut off time to reach bucket No. 1 at y and to turn around in same before leaving. The bucket and the jet travel in the same direction, but the jet travels more than twice as fast. In order to catch all the water it is necessary that distance $x^1 - y^1$ is equal to, or less than, the maximum length of the water cylinder which could be brought to strike each bucket. In the case in question this would require 17 buckets on the runner. Distance $x^1 - y^1$ is measured or calculated and $\frac{46}{100}$ of this distance is the bucket spacing measured along the arc. With this number of buckets all the water will be caught, but the shape of the bucket may be such that the last water particle has no chance to turn around and will pass out through the cut-out without giving off work. This can easily be detected on a drawing to scale and prevented by simply spacing the buckets a little closer.

Another reason for making the spacing a little less than maximum is to be able to take care of the possibility of the pressure in the pipe line dropping so as to decrease the spouting velocity considerably. If this drop should be say $\frac{100}{17} = 5.9$ per cent, eighteen buckets would be required to catch all the water. If the wheel had only seventeen buckets most of the water shown in Figure 1 lying between the lines representing cut-off of seventeen and eighteen buckets would never strike any surface, and, therefore, never give off any energy. The number of buckets should be kept as small as possible to keep the bucket friction low and discharge angle small. In this case, however, eighteen buckets would be the proper number to put on.

From Figure 1 can be seen that the maximum bucket spacing varies inversely with the diameter of the jet. When horse power output and head are given, the corresponding jet diameter is fixed.

$$\frac{\text{(Vol. of water per sec.)}}{\text{(spouting velocity)}} = \text{(Area of jet)},$$

And in this case it is $7\frac{3}{4}$ inches. This jet will develop 5600 k. w. with a generator efficiency of 96 per cent and a waterwheel efficiency of 80 per cent, and for this jet diameter the bucket spacing should be determined.

Fig. 2 shows the diagram of discharge. From experiments it is found that we have maximum efficiency when the speed of the pitch circle is 46 per cent of the spouting velocity, provided the spouting velocity is found from equation $v = \sqrt{2gh}$, where h is the effective head, in this case 1041.2 feet. The actual jet velocity is only about 95 per cent of this value and is decreasing continuously as the jet passes from the

nozzle tip to the point of exit on the bucket due to air friction, entrance loss and friction loss in the bucket and finally to the exit loss. This brings the average jet velocity down to about 92 per cent of the theoretical spouting velocity. Half of this value gives the most economical circumferential speed of the pitch circle, or 46 per cent of the theoretical spouting velocity. It will in most cases be found to vary between 46 per cent and 47 per cent. Any change in

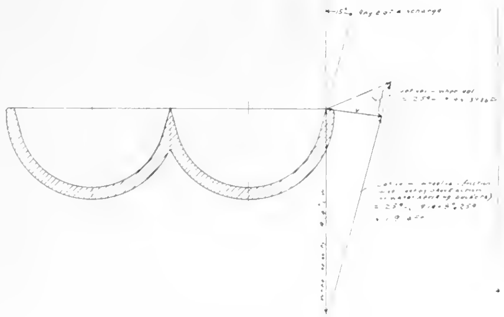


Fig. 2. Diagram of Discharge.

spouting velocity makes v (See Fig. 2) larger for constant wheel velocity. With very variable head, such as occurs when conduit is fed from a deep reservoir, or when conduit friction loss is large, the importance of designing the water wheel for the average head is therefore evident.

Entrance speed $w_1 = \sqrt{g.\ e.\ h.\ \frac{\sin \beta_1}{\sin(\beta_1 - \delta_1) \cos \delta_1}} = (1)$

Circumferential velocity $u_1 = \sqrt{g.\ e.\ h.\ \left(1 - \frac{tg\ \delta_1}{tg \beta_1}\right)} = (2)$

In these two equations we have but two variable factors for any given head β_1 and δ_1. Angle δ_1 is generally chosen between 20 degrees and 30 degrees, and can for practical reasons not be over 40 degrees. The only other means left for varying w_1 and u_1 is then by changing the value of β_1. For low heads a comparatively large circumferential velocity is wanted in order to get a cheaper machine; u_1 will be large when β_1 is larger than 90 degrees (then tg β_1 negative and — changes to + in equation (2)) and when δ_1 is large. For high heads a comparatively low circumferential velocity is wanted in order to keep the number of revolutions inside practical limits. β_1 smaller than 90 degrees will satisfy this requirement.

With $\beta_1 < 90$ u_1 also decreases with increase in angle δ_1 and where u_1 must be kept low large values of δ_1 are used besides small values for angle β_1.

From equation (1) it is evident that with β_1 larger than 90 degrees a smaller percentage of the total head is used for generating the entrance velocity than with β_1 smaller than 90 degrees.

A turbine working with high reactance pressure ($\beta_1 > 90$ low head high speed) would be but little affected by changes in head due to changes in conduit friction or otherwise, whereas one working with low reactance pressure ($\beta_1 < 90$ high head low speed)

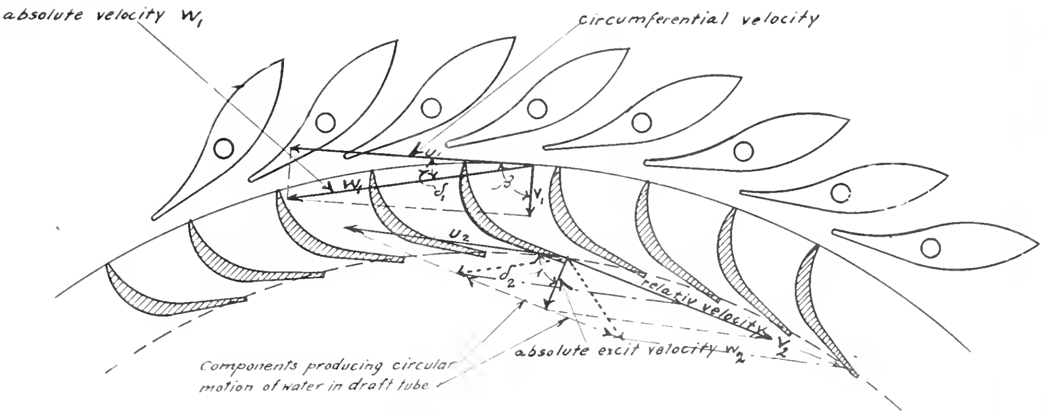


Fig. 3. Velocity Diagram of Turbine.

In reaction turbines the absolute velocity of the jet as it enters the runner it not that corresponding to the spouting velocity of the total head, but only to a percentage. By varying this percentage wide variations in runner speed can be accomplished. From Fig. 3 it is evident that, if entrance velocity w_1 is changed, either the circumferential velocity u_1, bucket angle β_1, or angle δ_1, between the entrance speed and circumferential speed must change also for shockless flow.

The relations existing between these different factors are

would be nearly as sensitive towards change in head as a tangential water wheel.

It is also seen that the circumferential speed of a runner is not fixed at 46 per cent of the spouting velocity, but can be varied between the limits of say 80 per cent and 46 per cent of the spouting velocity in different designs by the proper choice of angle β_1 and to some extent δ_1.

For medium head, medium speed $\beta_1 = 90$ degrees and equation (1) and (2) can be simplified to (tg 90 degrees $= \infty$).

$$u_1 = \sqrt{g.\ e.\ h.} \qquad (3)$$

$$w_1 = \frac{1}{\cos \delta_1} \sqrt{g.\ e.\ h.} \qquad (4)$$

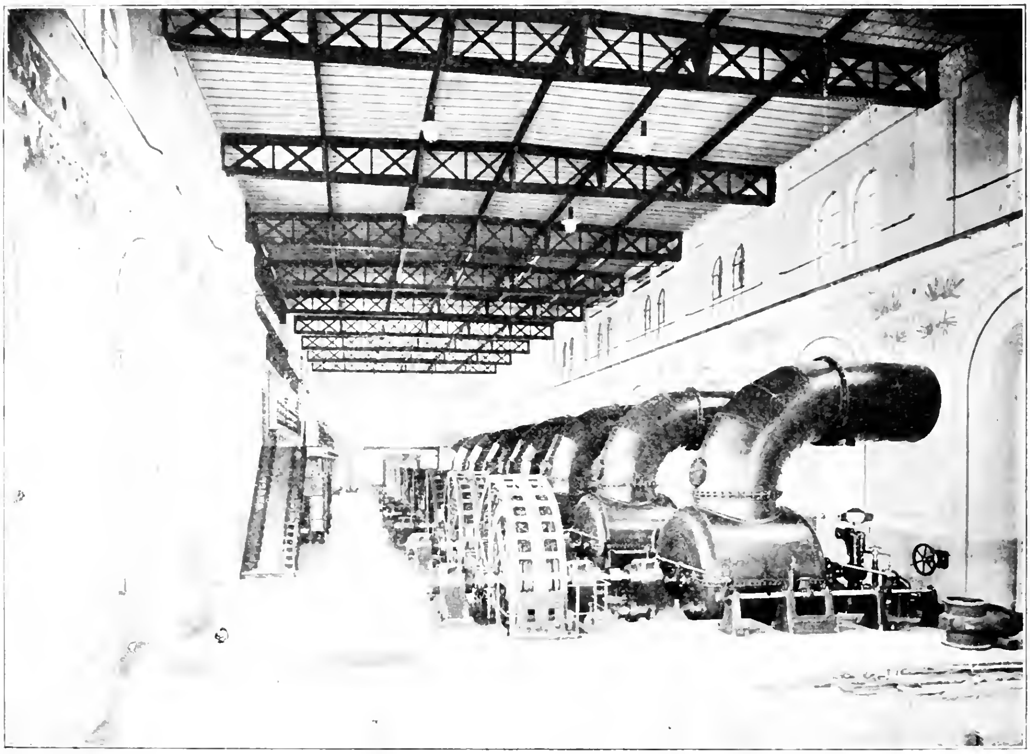
If the conditions given in equations (1) (2) (3) (4) are fulfilled the relative velocity v_1 will have a direction parallel to the buckets at the entrance, and the water will flow from the guide vanes over into the runner without shock and we will have maximum efficiency. This condition exists only at one load, usually three-quarters full load is chosen.

At any other load the position of the guide vanes is different, that is, the value of δ_1 has changed, and as the circumferential speed stays constant, the relative velocity v_1 changes, both in magnitude and direction. The water cannot flow shockless into the runner now because its direction is not parallel to the first bucket elements any longer. Here is where the turbine differs from the tangential water wheel. In the latter the entrance is shockless at all loads (if at any); therefore, its efficiency is higher than the efficiency of a reaction turbine on partial loads. In other words, the efficiency curve is flatter over a larger range of load.

For comparative efficiencies of tangential water wheels and different types of turbine see Fig. 5, which is copied with permission from Professor Daniel W. Mead's book "Water Power Engineering."

The water flows through the turbine runner with increasing velocity. This velocity fluctuates necessarily with the load. Maximum load requires maximum velocity of flow, as the quantity Q of water is maximum and the areas through which the flow passes are constant. The exit loss α_2 is chosen from 0.04h to 0.08h (part of this loss can be regained by proper use of draft tubes) and the absolute exit velocity w_2 is easily found from $w_2 = \sqrt{2\ g\ x_2}$.

For maximum efficiency the direction of w_2 should be axial and the turbine is generally so designed that when ¾ Q is flowing through it, this is the case. At any other load we will have two components, one in an axial direction (towards the center in Fig. 3), and the other in a tangential direction. This latter has a tendency to set the exit water in a rotating motion and is lost. A large part of the axial component of W can be regained by the use of correctly designed draft tubes.



Turbines in Hydro-Electric Plant at Vizzola, Italy.

From the above it is evident that the exit loss is minimum only at one load usually at ¾ full load, where the direction of w_2 should be axial, and that this loss is proportionally larger at all other loads. The tangential water wheel has a practically constant exit loss, that is, the same percentage of head is lost at all loads with no increase at partial loads.

Which of the two machines is the more economical will depend upon load conditions. The turbine can be designed to have maximum efficiency at one load

only. This maximum efficiency is sometimes higher than that which can be attained with a tangential water wheel; this latter, however, keeps its maximum efficiency over a much wider range of loads and for a greater number of years. In the reaction turbine the full head can be utilized. So far only a few attempts have been made to provide the tangential water wheel with draft tubes, although they would do more good here than on turbines. Besides utilizing the extra head, the windage would decrease with increase in

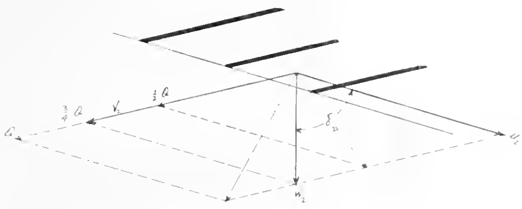


Fig. 4.

vacuum. The extra gain from this cause may amount to from ½ per cent to 1 per cent with 15 inches of vacuum. It should, therefore, be worth while for the manufacturer to consider the application of draft tubes to tangential water wheels.

APPENDIX.

From the standpoint of an operator it is not so interesting to know how a turbine is designed as it is to know how to detect existing faults and how best to remedy them.

Take a tangential water wheel first. Is the efficiency low or supposed to be low an easy way of finding if there is actually something wrong without going to the trouble of testing the machine is as follows:

Set the deflecting nozzle in its normal position, that is, the position from which it directs the water in such a way that the jet intersects the vertical center line through the wheel under an angle of 90 degrees. The point where the center line of the jet intersects the vertical center line through the wheel is one point of the pitch circle. The velocity of this point can now be calculated, as the pitch diameter can be measured and the r. p. m. are known. The effective head is measured when the wheel is running normally loaded by means of a pressure gauge. To this head should be added the velocity head of the flowing water in the pipe (this does not amount to much and can be neglected. For instance: For 12 feet velocity per second in the pipe line this would give an additional head of only

$$\frac{v^2}{2g} = \frac{12^2}{2g} = \frac{144}{2 \times 32.16} = 2.2 \text{ ft., or for 1000 ft. head} = 0.22\%$$

The theoretical spouting velocity is found from $v = \sqrt{2gh}$ and if the speed of the pitch circle is not pretty close to 46 per cent of this value, the wheel is not running under the head which will produce maximum efficiency. To investigate further, the unit should be run separate and the generator loaded with a water rheostat. With constant jet diameter the water rheostat should be adjusted until we have maximum output and then the corresponding speed measured.

At this speed the wheel must have its maximum efficiency because it gives off maximum amount of power with constant discharge and it will be found that this new speed is just 46-47 per cent of the speed of the jet. It is never any higher, except perhaps in the Hug wheel, which discharges from a considerably smaller diameter than the pitch diameter, and, if it is lower, shows that the bucket shape is wrong, the entrance loss, the bucket friction loss and the exit loss are too large.

The generator must run in synchronism with the

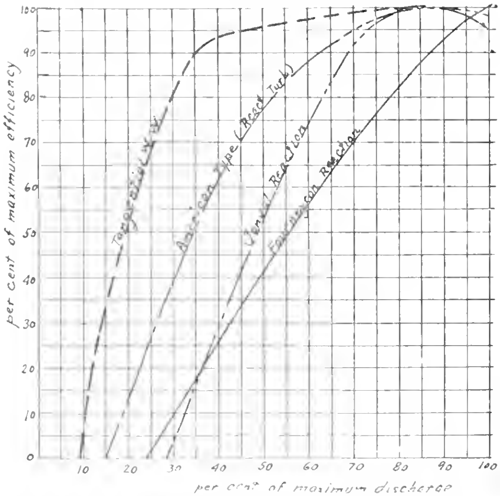


Fig. 5. Comparative Efficiencies of Tangential Water Wheels and Turbines.

system and the speed is, therefore, fixed. Should the most economical speed, which is the same for all loads, be found to be much off this normal speed, the only remedy is to put on longer buckets if the velocity of the pitch circle is too low. This is not an elegant solution, but will help the efficiency. Should the velocity of the pitch circle be too high, there is nothing to do but get a new runner of smaller and more correct diameter, as in this case we may lose water between the buckets in addition to the inefficient action of the water upon the bucket surfaces.

In much the same way faults in a reaction turbine can be detected without going to much trouble and expense in making complete test. With generator running normally loaded the turbine should be about ¾ full loaded and run at point of maximum efficiency. This would require that the direction of the absolute discharge velocity w_2 be axial, and, if so, the water will leave the draft tube without any disturbance. At any other load or any other speed but the one which produces axial discharge, and, therefore, maximum efficiency, the discharge water from the draft tube will have a rotating motion due to the tangential component of the discharge velocity w_2 (see Figure 3 and 4). From the direction of rotation can be judged (with only one runner for each draft tube) from keeping Fig 3 in mind, whether the speed is too high or too low for maximum efficiency at the output developed. It is also well in this case to load

the generator with a water rheostat and find the speed at which ¾ Q develops maximum k. w. If this is not the speed at which the generator normally must run, it shows that the turbine does not run normally at its best efficiency. Is the normal speed too high, a remedy may be found in changing the draft tube if this is not already perfect. The water should flow through the draft tube with uniformly decreasing axial velocity. The area of any horizontal section (see Fig. 6) multiplied by its distance above the bottom of the tail race should be constant (shape approximately a hyperbola). Expressed in a formula this would read

$$D^2 \frac{\pi}{4} Z = \text{constant} \qquad (7)$$

from which follows

$$D_3^2 w_3 = D_4^2 w_4 \sin\delta_4 \qquad (8)$$

where w_3 is the velocity through the upper section with dia. D and $w_4 \sin. \delta_4$ is the velocity in axial direction at the outlet with diameter D_4.

If D_4 is too large the turbine will alternately lose part of its vacuum and pick it up again. This can be prevented by making Z_4 smaller; the proper value found from (see Fig. 6)

$$\frac{w_4 \sin\delta_4}{Z_4} = \frac{w_3}{L_s + Z_4} \qquad Z_4 = L_s \frac{w_4 \sin\delta_4}{w_3 - w_4 \sin\delta_4} \qquad (9)$$

The gain in head from reducing the velocity w_4 to $w_4 \sin. \delta_4$ is found from

$$\frac{w_4^2}{2g} - \frac{(w_4 \sin\delta_4)^2}{2g}$$

and may easily amount to as much as 4-5 feet,

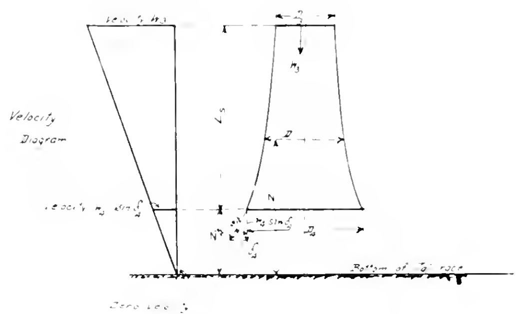


Fig. 6.

which, especially on low head, may be sufficient to remedy the evil of the runner speed being to high. If the draft tube is provided with a bend only equation (8) holds. Here w_4 should be slightly larger or equal the tail race velocity.

If the runner speed is too low for normal load, there is nothing to do but put in a new runner and change angle β_1 to satisfy equation (2) at the given u_1 and δ_1.

On the existing runner β_1 can be measured δ_1 for normal load (3 4Q) can also be measured and u_1 figured out from the known outside diameter and the r. p. m. In the value of w_1 as found from equation (1) we have a good check of the correctness of the runner speed u_1. This speed $\frac{\pi d n}{60}$ u_1 should be equal $w_1 \cos \delta_1$ (see Figure 3) and if β_1 is not 90° then $u_1 \frac{\pi d n}{60}$ should be equal $\frac{w_1 \sin(\beta_1 - \delta_1)}{\sin \beta_1}$ and if this is not at least approximately the case entrance of water into the runner cannot follow shockless. The hydraulic efficiency e must be assumed and for an old turbine may not be over 75%. The only remedy is to charge β_1, which means a new runner.

DISCUSSION

Geo. J. Henry: I have not come specially prepared to say anything on this paper. I had the pleasure of reading it over the other evening, and several questions came into my mind.

Mr. Jorgensen has not told us anything about the efficiency obtained from that tangential water-wheel. I do not know whether any test has been made of it. It is a very large tangential wheel; the design has been almost forced; it is a condition of stream and speed which do not lend themselves readily to the best results obtainable from tangential water-wheels. Several makers have built a water-wheel for those conditions, and I think every one of them has felt that if the conditions could have been changed—if the stream could have been made smaller, or the wheel diameter could have been made larger, it would have shown up very much better in design and operation. In the travel of a stream of water through the series of tangential water-wheel buckets the stream will spread some. Mr. Jorgensen's sketch here shows it spread a little bit; and he probably intended that, although I did not gather it from his blue-print. The stream does actually spread, and as a result the water would begin to leak through on the point of the periphery very much sooner than it would if the stream retained its actual parallel shape. The result is you have to decrease the bucket spacing a little bit in order to catch all that stream.

Another point he mentioned in connection with the wheel under consideration was in regard to the pitch circle. I think we are all accustomed to think of the pitch circle as a circle which is a tangent to the center line of the stream. The center line of the stream is really not the pitch circle that we are all interested in. What we are all interested in is to secure the maximum quantity of water discharged at as nearly zero velocity as possible. As Mr. Jorgensen stated, you must take into account all of the losses that occur in that water, all the reduction in velocity that occurs in the water up to the point of its leaving the bucket edge. Now it will be perfectly obvious to you that if this is a plan of a water wheel bucket (referring to diagram), the water enters here, and travels around the cup; it spreads out as it goes around and discharges at some appreciable angle. Now of course there is a loss, roughly equivalent to the component of velocity of this direction; there is a loss due to that exit velocity; but the water should travel off from that bucket in that axial direction to get the best results. That velocity with which it leaves, is a loss. On the other hand the point at which it leaves the bucket is a very interesting point, and really the one that determines the effective pitch circle. If the water enters the bucket at the center line of the jet, this the angle, and this is the bucket, the water will travel around on an interior curved surface, and discharge at some point like that (illustrating); or may be, if the bucket be tilted in this direction, and it comes in here, it will turn around and discharge at some point like that. Now at this instant, that is really the point that we are interested in, and it is perfectly apparent to you that that is really a larger pitch circle than this one tangent to the stream center, and yet that is the

circle that we must calculate for; and if the bucket occupies this angle, our circle would naturally be one having a very different radius.

Mr. Jorgensen mentioned that when the tangential wheel slowed down a considerable increase in energy occurred, if I caught his meaning correctly. I also want to call attention to the fact that when a wheel over-spreads, for instance, if this be the efficiency curve of our water-wheel with reference to speed, ordinates being speed, and absciss being efficiency, that curve will run over like that beyond the point of max efficiency, and at this point it will suddenly take a dip so (illustrating). That is due to the water escaping through the buckets. As Mr. Jorgensen stated to us, when the wheel runs a little too fast, or when it has too few buckets, some of the jet will escape through; and whatever escapes through of course is lost. Now if we have just exactly the right number of buckets on our wheel, this cut will take place at the maximum efficiency point like that. If we have, as he suggested, one or two extra buckets on the wheel, so as to bring the extreme limit near here, to the point he has marked 18 instead of 17, we will get this curve, cutting the wheel efficiency curve at a point somewhat beyond the maximum efficiency point. That takes place ordinarily a little closer than I have shown it, probably in that position. Now if we are regulating a tangential wheel with a deflecting nozzle or any other device, and we get an over-speed condition, then for a moment the great drop in wheel speed efficiency will be a great aid in holding down our speed and therefore in securing better speed regulation.

Another thing over which there has been a great deal of discussion among electrical people in connection with the use of tangential water wheels, has been the maximum speed which a tangential water wheel will attain when the circuit is open or the field is killed. It is apparent to you that due to the jet of water running through the buckets, and this inverse curve occurring as I have shown it here, that the great drop in tangential speed efficiency will result in our speed never reaching anything like spouting velocity. If you think of it for a moment like a rack and pinion, the teeth of the pinion being the buckets of the wheel, and the rack being the stream of water, you will see that if the buckets are running at the same speed as the jet of water, there will be no impulse against the buckets; the water will run through without impact. Now the wheel cannot possibly attain that speed because there will have to be enough energy taken out of the water for the windage and friction.

Another point in connection with the use of large jets on small diameter wheels. If we have a bucket like that, and put a large jet on it, this volume of water which I have shown here in cross-section, one-half the jet will have to spread itself on this bucket surface, and it will have to spread itself out pretty thinly to make this angle of discharge small. The result is, if we increase the diameter of our jet considerably, it is necessary for us to widen the bucket out very greatly. If that bucket be widened out so that it discharges—and the bucket is large in proportion to the wheel—and the discharge takes place over that whole distance, the result will be that there will be one filament of water which discharges at the correct velocity—the minimum velocity, the upper lines of water will discharge at a very different velocity—a much larger velocity, and the lower lines of water will discharge at a very much larger velocity, with the result that there is only one filament of water which gives us the best efficiency; whereas if we have a very large diameter wheel nearly all of the water will discharge at the best efficiency speed, or the "nearly" zero speed.

Another point is, this large volume of water discharging into a tail-race at nearly zero velocity requires a considerable pitch in the tail-race, or a considerable drop from the wheels, or else some initial velocity left in it for the purpose of throwing itself out through the tail-race.

Those are all points I think very important in water-wheel design. If any of you are interested in testing out water-wheels you will probably run across them.

L. Jorgensen: Mr. Henry has said nothing that I need to answer, or can answer. The only thing about the buckets (the figures here), the average of these two will be the pitch diameter and the pitch circle; and as I say in my paper, the point where the last water particle leaves the bucket, they can only be found on a drawing drawn to scale. Mr. Henry has added to my paper.

William A. Doble: Mr. Jorgensen's remarks are always instructive. The question of draft-tubes which he has brought up as applied to tangential water wheels has not come into general practice more than it has for the reason that as a rule the head of the draft tube is a very small proportion of the total head, and it does not pay. We made our first wheel with a draft tube some years ago, and we are now building some large ones, but it is only in exceptional cases where the draft-tube head forms a reasonable proportion of the total head. Of course as we develop lower heads for the use of tangential wheels, then the draft tube will come more into play.

The question under discussion of the bucket spacing and such features I do not particularly care to take up, but the draft tube is one of the interesting things.

H. W. Crozier: Mr. Jorgensen has told us about methods of measuring the best speed; and I had occasion to do that for the purpose of determining whether some wheels were operating under best speed, and used exactly the method he has stated of turning on a certain size jet, and running the generators at various speeds until I found the speed which would give the largest load. I found in the case of the three generators that we were testing that the wheels were a little larger than was required. It made a difference of something like 15 per cent additional output for only a small change of 5 or 10 per cent in speed, showing that the question of the correct speed for the water-wheel is quite important.

S. J. Lisberger: Mr. Jorgensen stated that if you added a draft tube to your tangential wheel it would probably increase the capacity of the machine about one per cent. What percentage would that add to the cost of the machine?

William A. Doble: That is too variable. It depends on the size of the unit and other conditions, and also on the total head and the proportion of draft-tube head to total head. Another thing, the draft tube is not 100 per cent efficient. You have additional friction and the other elements to add, so it is hard to say. You have to treat each case by itself. We are now building a 3600 h. p. wheel on which we will put a 15 foot draft tube head, and it will operate under 240 foot total head, and there we will expect to gain materially; but for that size unit the total head is rather smaller than we ordinarily work to under tangential wheels of large capacities. There we will gain too, but if the prime head is much higher it would not pay to put on the draft tube. The draft tube has added fully ten or fifteen per cent to the cost of the apparatus; and then draft tubes sometimes have very strange freaks that they play with questions of regulation, and there are some disagreeable features connected with it, so much so that even in turbine practice a draft tube is not used unless it represents a reasonable proportion of the total head. Some turbines are run practically by their draft tubes; but in the development of the tangential wheel on the Pacific Coast, where the wheels are ordinarily placed in the mountains, where the heads are high, the question of draft tubes would not justify. Of course now that the higher heads are being used up, and we have to go into lower heads, the draft tube justifies consideration. It is one of those things that has to be worked out for each case. You cannot lay down any rule for it.

S. J. Lisberger: That freak of regulation that you speak of is surging?

William A. Doble: Yes.

H. B. Crozier: Do you obtain any material gain by the draft tube by decrease of friction? It appears to me, although you may decrease the head, you cannot by any means get away with the spray in the case. The natural friction losses are directly proportional to the specific weight of the material; and the amount of spray that you undoubtedly encounter in the case of a water wheel would be far greater than the air.

William A. Doble: Yes, we do take into consideration the fact that we will gain materially by reduction of the air resistance due to the partial vacuum. The spray in a properly designed tangential wheel is not as great I think as you indicate, not from my observation. That is one of the elements of loss that we have to contend with, namely, the friction loss due to preventing the air leakage into the housing.

A Member: Mr. Henry remarked about the runaway speed of it. Isn't it nearly double ordinary speed? I would like to ask approximately what it is in proportion to the ordinary speed, referring to the tangential wheel particularly.

Geo. J. Henry: The runaway speed of the tangential would of course be variable, that is, different wheels and different conditions will give you different runaway speeds. The larger the buckets are the greater the windage will be; and in ordinary practice I should be very much surprised if the runaway speed was 75 per cent above normal. I should consider that an extreme case.

A Member: How about the turbine?

Geo. J. Henry: The turbine is a different proposition altogether. A turbine ordinarily runs at usually from 60 to 70 per cent of the speed velocity, I mean at normal speed. Now the runaway condition there of course cannot be compared with the tangential wheel as if it ran at 50 per cent of the spouting velocity. I do not think it would reach anything like spouting velocity in any case, and therefore I would not expect it to run more than say 40 to 45 per cent above normal velocity.

A Member: With reference to the low head that has been spoken of, how many wheels did you have to use for that low head?

Answer: Two.

L. R. Jorgensen: Mr. Doble remarked that he would not care to discuss the method I used for finding the bucket spacing. The method is correct and one of my own, but I must admit that it is somewhat more clumsy than the one he uses. I shall always be thankful for what I learned while working for Mr. Doble and therefore did not feel free to give out information obtained from him.

The meeting then adjourned.

PRICES OF ARC LIGHTS IN CONNECTICUT.

President Wiegand of the Hartford Board of Public Works has compiled the following table of contract prices for street lights in several Connecticut cities.

City	Number of Lamps	Price per Lamp	Hours of Burning per year
Hartford	800	$70.00	4,000
Bridgeport	630	79.75	4,000
New Haven	600	86.00	4,000
Waterbury	500	87.50	4,000
New Britain	180	85.00	4,000
Meriden	200	100.00	4,000
New London	208	85.50	4,000
Willimantic	..	92.50	4,015
Rockville	80	75.00	....
Stamford	38	85.00	4,000
Bristol-Plainville	110	67.50	2,500
Danbury Bethel	125	67.00	2,400
Putnam	51	81.70	2,250

POWER AT PORTLAND, OREGON.

BY A. H. HALLORAN

Water has become so universally associated in the public mind with the flotation of over-capitalized industrials that it affords a sense of relief to find one of the most substantial and conservative cities in the West whose permanent prosperity rests upon water. The Columbia river, with its fish, its timber, its farms and its power, is the water; Portland, Oregon, with its position, its harbor and its people, the city. The vast territory, "where rolls the Oregon" and its tributaries now occupied by a busy people, finds its natural outlet through Portland. The latest link in this chain of progress is provided by electric power, generated by water.

Portland's power at present is supplied by the Portland Railway, Light & Power Company, although there are several other projected developments which may eventually be in the same market. The purpose of this article is to briefly summarize what has been done by the former and may be done by the latter.

The chief source of power for the Portland Railway, Light and Power Company is at the falls of the Willamette river at Oregon City and at the falls of the Clackamas river at Cazadero, the Clackamas being tributary to the Willamette several miles above Portland and the Willamette entering the Columbia river several miles below. The Oregon City plant was admirably described in this journal in August, 1905, and the Cazadero plant, which was completed in February, 1907, has also been described so often as to make another detailed account unnecessary.

OREGON CITY PLANT.

At Oregon City, fifteen miles south of Portland, twelve General Electric alternators furnish 5,730 k. w., three-phase, 33 cycle current at 10,000 volts, which is transmitted at the same voltage by pole lines on both sides of the Willamette river to Portland. Ten of these generators are mounted on vertical shafts direct connected to 42-inch and belted to 60-inch Victor turbines. This duplication of water-wheel units is necessary because the head varies from a maximum of 40 to a minimum of 20 feet at times of high water below the falls, caused by back water from congestion on the lower river. According to the head either the small or large wheels or a combination of the two are used. The other two generators mounted on horizontal shafts are direct connected to 51-inch McCormick turbines. Cylinder gates and Replogle governors are used throughout. Exciting current is furnished by two 200 k. w. direct current generators driven by 42-inch Victor turbines and an auxiliary 85 k. w. dynamo belted to the McCormick turbine shaft. A 1500 k. w. frequency changer set converts a part of the current from 33 to 60 cycles and two 400 k. w. rotary converters supply direct current at 550 volts to operate the electric railway between Portland and Oregon City. The Falls of the Willamette were first utilized for power in 1854 and most of the present equipment has been installed since 1893.

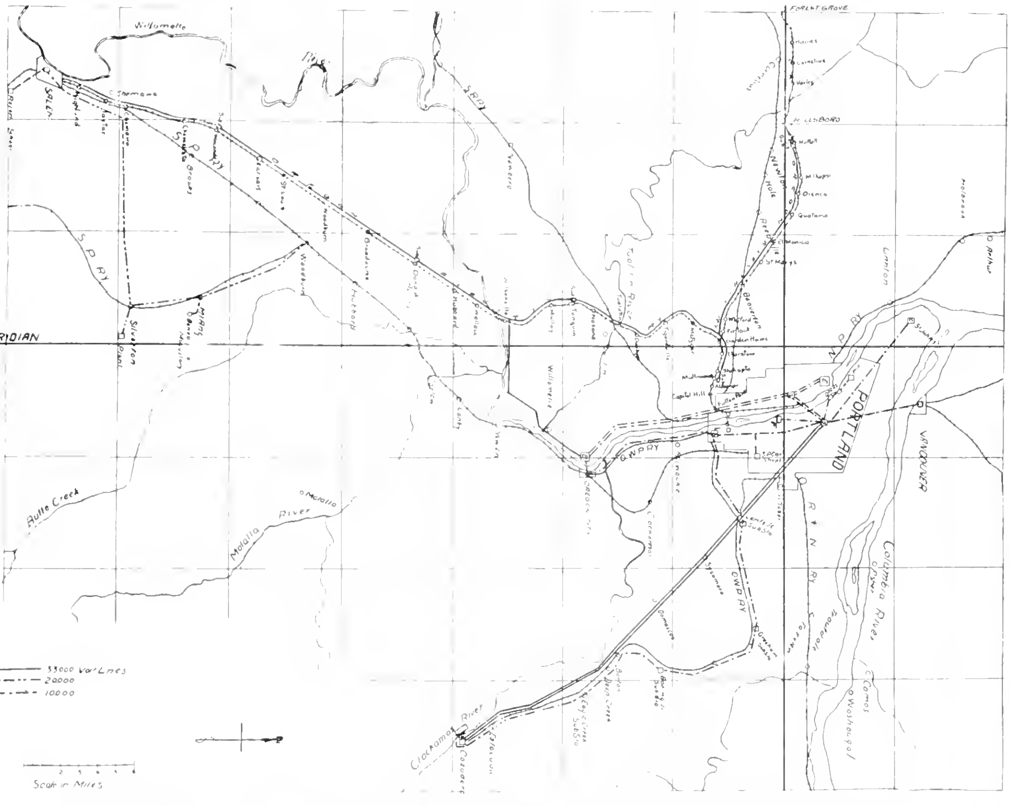
CAZADERO PLANT.

The original installation at Cazadero consisted of three 5000 h. p. 42-inch Francis turbines, horizontal type, built by the Platt Iron Works and operating

under a head of 125 feet, a diverting dam, ditch, flume and reservoir supplying water from the Clackamas river 17 miles above the power plant. The wheels are direct connected to three 2500 k. w. generators, giving alternating current at 10,000 volts. It is at this plant, about a year ago, that one of the water wheels running above 500 revolutions per minute caused its generator to fly to pieces by centrifugal force, also putting the other set out of commission and shutting down the plant. Fortunately no one was injured. This damage was repaired in record time, a 2500 k. w. General Electric 10,000 volt, 60 cycle alter-

site for a contemplated concrete dam, 150 feet high is being examined and tested. This will give a head of the same height to the entire volume of the Clackamas river, which could be utilized by a power plant at the foot of the dam, making unnecessary further head-works. This will form the scene of the company's next operations when the demand warrants, a strong probability within the next three or four years.

Along the line of the company's 38-mile railway between Portland and Cazadero, sub-stations at Lents, Gresham, Boring and Eagle Creek have rotary con-



Map of High Tension Transmission Lines of the Portland Railway, Light and Power Co. and Oregon Electric Co.

nator being immediately diverted from another purpose and two 2500 k. w. Allis-Chalmers 10,000 volt 33 cycle generators subsequently installed.

Another unit, a 5500 h. p. Francis turbine similar to its mates, upon whose shaft will be mounted three 1000 k. w. 2300 volt, 60 cycle General Electric alternators, is now being installed, the generators being obtained from a discarded frequency changer set at sub-station A in Portland. During the coming summer the voltage on the 31-mile transmission line between Cazadero and Portland will be raised from the present 10,000 to 33,000 volts, additional transformers now being installed.

Two miles above the dam at Cazadero a splendid

verters supplying direct current at 550 volts to the railway circuit, being supplemented by a 500 h. p. steam engine at Boring and a storage battery at Cazadero, giving 1,000 ampers for 20 minutes at 550 volts.

STEAM AUXILIARIES.

Two stations in Portland, E and F, generate 6750 and 1300 k. w. respectively. Station E contains two 2500 h. p. Curtis steam turbines driving two 1500 k. w. General Electric alternators, 10,000 volts, 3 phase, 33 cycles, two 1500 h. p. marine engines driving two similar 1000 k. w. generators, and also engine driven generators developing 800, 750 and 200 k. w. The boiler equipment includes ten 520 h. p. Cahill water tubes,

four 125 h. p. and ten 100 h. p. tubular boilers, all arranged so that they can burn either oil or sawdust; the latter being automatically stoked into Dutch ovens by motor-driven conveyors. Station F forms a reserve, not being regularly used. Several years' use of sawdust has shown it to be a satisfactory fuel, giving a hot fire at low cost. Oil is burned only when there is insufficient sawdust.

SUB STATIONS.

In addition to those already described, sub stations are placed at Seventh and Alder streets, Williams avenue and Knott streets, Sellwood, St. John and Piedmont, the last three being suburban. The Oregon City lines and station E are tied to that at Seventh and Alder, the Cazadera lines, Station F and other sub-stations to that at Williams and Knott. These sub-stations are all well built and equipped. That at Seventh and Alder is to be a part of the magnificent office building the company is now building. Its chief equipment is to be rotary converters, as under a recent ruling of the city all lines in the business section must be underground, direct current being distributed at 220 volts. Elsewhere, except for railway service alternating current is used.

UNDERGROUND DISTRIBUTION.

The underground distribution system is well under way. Excavation in standard practice is made one foot from the curb to a depth of from four to six feet, depending upon obstacles. When the streets are asphalted it consists of six feet of ditch alternating with four feet of tunnel. Oval man-holes, generally four feet across by eight deep are placed at each corner, being built with concrete walls and sewer connection with automatic back water trap and provided with ventilating covers.

The mains are three-wire conductors, with grounded neutrals and frequently tapped with feeders to maintain voltage. These cables are laid in clay conduit, 24 and 30 inches long, and of 3, 4 and 6 duct sections, with 2½ and 3 inch bore. The conduit is placed on a 4 inch concrete foundation, burlap connected and concrete encased to within two feet of the surface. Cables are drawn in by the usual rodding method.

OTHER DEVELOPMENTS.

In addition to [illegible] organization the company supplies [illegible] its own electric railways in Portland [illegible] maintaining a [illegible] plant at Vancouver [illegible] current to the Oregon Electric Railway [illegible] and to the United Railway Company [illegible] recently completed [illegible] railway between Portland [illegible] 33,000 volt line [illegible] and [illegible] building 15 [illegible] Railway Light & [illegible] electric railway [illegible] completed and is operating fourteen miles of electric railway between Portland and Burlington and is building a 60 mile extension to the west.

Recently organized is the Portland Water Power and Electric Transmission Company, which proposes to develop 12,500 h. p. on the Clackamas river, two miles below Cazadero. F. S. Morris of Portland is interested and G. I. Brown is the engineer. Considerable work has been done east of Portland at Bull Run by the Mt. Hood Railway & Power Company, of which E. P. Clark of Los Angeles is president and F. C. Finkle of Los Angeles consulting engineer. This work has been discontinued since the panic of 1907. It was intended to furnish current to the Portland-Eastern Railway Company, a subsidiary concern.

In addition to central station supply, there are also several isolated plants such as in the Portland Hotel, and the Corbett building, the latter being noteworthy because of its storage battery equipment.

Executive offices are maintained in Portland at the Willamette Valley Company, operating plants at Eugene, Albany, Corvallis, Independence and Dallas, as well as a system of electric railways which is planned ultimately to unite all towns in the upper Willamette Valley. This company is a subsidiary of the Northwestern Corporation, of which I. W. Anderson is president, with headquarters at Spokane, Washington. Another project is that of the Portland, Baker City and Butte Railway Company, in which C. D. Charles is interested, owning water rights along the Deschutes river in Eastern Oregon.

Wireless telephony over 100 miles was recently maintained in a test of the Colin-Jeance system at Toulon, France.

Examination for Aid, coast and geodetic survey, is announced by the United States Civil Service Commission on July 8-9, 1909, to fill four vacancies in the position of deck officer, at $75 a month each, in the Coast and Geodetic Survey, and vacancies as they may occur in the positions of aid and deck officer in that Survey.

Examination for topographic draftsman is announced by the United States Civil Service Commission on July 14-15, 1909, to fill a vacancy in the position of topographic draftsman, $900 per annum, Coast and Geodetic Survey, and vacancies requiring similar qualifications as they may occur in any branch of the service. The salary of the position of topogrophic draftsman ranges usually from $1000 to $1500 per annum.

Examination for architectural draftsman is announced by the United States Civil Service Commission on July 14-15, 1909, to fill a vacancy in the position of architectural draftsman, $1500 per annum, Quartermaster's Department at Large, Philippines Division, and vacancies requiring similar qualifications as they may occur in any branch of the service. Appointments to this position in the Supervising Architect's Office, Treasury Department, are made at salaries of $1200 per annum and upward.

REPORT OF THE SIXTH ANNUAL CALIFORNIA STATE CONVENTION OF THE NATIONAL ASSOCIATION OF STATIONARY ENGINEERS.

Held June 14-19, 1909, at Auditorium, Page and Fillmore Streets, San Francisco, California.

Meeting called to order by Mr. P. L. [illegible] in the [illegible] 8.10 in the assembly room of said building.

The Chairman. We have assembled here this evening to take part in the opening exercises of the [illegible] under the auspices of the National Association of Stationary Engineers—the Sixth Annual Convention [illegible] evening must necessarily be limited. [illegible] one of the greatest, either State or [illegible] and will continue until Saturday, [illegible] opportunity of thanking the [illegible]

[illegible] invoking a blessing of God [illegible] Mr. Rader who will now [illegible]

[illegible] Gentlemen, I [illegible] the [illegible] to you and introducing the [illegible] his Honor, the [illegible]

[illegible] great pleasure [illegible] presence, and

Newly Elected Officers California Association N. A. S. E.

[illegible]

[illegible]

The Chairman: Ladies and gentlemen, [illegible]

[illegible]

[illegible] are taught. In regard to this fair. We as individual members of the association and citizens of this city, and as employers, are in a position to see what has been accomplished, and has been done here during the past three years in rebuilding San Francisco. We saw San Francisco wiped out within a few hours, and we have seen it phoenix-like rise out of the ashes, and the rapidity with which it has been rebuilt and the substantial way in which the old has been replaced by the new has been the marvel of the world. We fear however, that the importance of the engineer is not fully understood by the business or business men, but our interests are knitted to the business relations so closely that he seeks to demonstrate to the business man and [illegible] our mutual benefit and interest in the upbuilding of our city and the manufacturing business in our new San Francisco, with her beautiful buildings, beautiful churches and beautiful homes, and I hope that we can look back to this event as the starting point to the regeneration of the manufacturing business and other industries of a like nature. Ladies and gentlemen, there is much to be said on this subject, but above all the welfare of our beloved city is first, and I know that these gentlemen

Delegates Sixth Annual Convention California Association N. A. S. E.

[illegible]

who have worked [illegible] committee for the past [illegible] within their power, [illegible] that our city is being rebuilt even more [illegible] than before.

[illegible] Ladies and gentlemen, this concludes this part of [illegible] and I would ask the audience to kindly retire to [illegible] end of the hall on both sides, and [illegible] Mayor, [illegible] touch the button which will [illegible]

TUESDAY, JUNE [illegible], 1909.

[illegible] by State President [illegible] I now declare the Sixth Annual Convention of [illegible] N. A. S. E. open for business, and will introduce Brother [illegible] who will give us a few remarks.

[illegible] pleasure to attend [illegible] meeting of the California State Convention, and I think it [illegible] California State Association [illegible] thank the San Francisco delegates [illegible] members for bringing this about and I

am satisfied that your members do not regret that they belong to the State Association. The fine exhibit that you have given us here surpasses anything that the National Association ever attempted.

The balance of the session was occupied by the appointment of committees and in discussion of a suitable certificate of membership.

WEDNESDAY'S SESSION, JUNE 16

This session was largely devoted to a discussion of the [illegible] of representation at the National Convention.

SATURDAY SESSION, JUNE 19

After indorsing action that would make all subordinate associations members of the State Association, and selecting Los Angeles as the next meeting place, the following State officers were elected and installed: President, J. N. Pyster; Vice-President, George C. Turner, Stockton; Secretary, W. T. W. Curl; Treasurer, Chas. Knights; Conductor, John Maher; Doorkeeper, George Byers; Trustees, E. A. Stanley, Conrad Wetzel, Geo. Miller; Past President, H. D. Saville.

In conclusion, Past President Saville made a motion that the members extend a vote of thanks to National President Fisher for his attendance at the State Convention, and also that the members

J. N. Pyster, President California Association, N. A. S. E.

of the San Francisco association tender a vote of thanks to the general arrangement committee for the efforts in getting up such a good exhibition.

The motion was put and carried by a rising vote.

F. S. Fisher: I assure you brothers that the pleasure was all on my side in coming to this convention, and I assure you that it was one of the happiest moments of my life to be able to attend this convention and such a magnificent exhibit as this association has given, and if all the conventions would give such an exhibit as this in five years we would have 50,000 members, and I know that this convention has done a lot of good with the manufacturers and supply men and business men in general—it has brought the engineers and business men closer together, so that they understand each other better, and I dare say that the engineers understand each other better than they did before and some of the engineers who do not belong to the association came to me and shook me by the hand and said Brother Fisher we are going to be with you, which was the happiest moment of my administration. All I can say is God bless you boys, and I thank you.

Upon motion duly seconded, the convention adjourned sine die.

On Saturday night at the close of the Mechanics' Fair 350 delegates, members and exhibitors celebrated the success of their joint efforts at a banquet. The menu was appropriately printed on sheet asbestos supplied with the compliments of the H. W. Johns-Manville Co.

MENU

Toke Point Oysters a la Poulette
Spark Plugs and Fuel Oil
Sauterne Anhydrous Calcimined Almonds
Entree
Sweetbread Pattie a la Chief Engineer
Spanners Wrenches
Roast Chicken with Current Jelly
Surrounded in Tank and Asbestos Packing
Romaine Salad
non-liquid Oil Dressing
Appollinaris H₂O Fancy Ice Cream
Hexagon Nuts, Washers and Assorted Bolts
Cigars Induced Draft
Cafe Noir
Boiler Compound

SOUVENIRS

Souvenirs were the order of the week, practically every exhibitor having arranged to present something in the way of a reminder to their numerous visitors. They were all desirable and in great demand. Some of those attracting particular attention were as follows:

W. P. Fuller Company, crayons.

Fricke & Smith Company, watch fobs.

Peerless Rubber Company, smoking pipes.

Maryland Casualty Company, paper weights.

Selby Smelting & Lead Company, miniature metal ingots.

John Finn Metal Works, babbitt metal anvils for use as paper weights.

Henshaw, Bulkley & Co., pocket match box for the men and fans for the women.

Simonds Machinery Company, watch fobs with miniature Marsh pumps as pendants.

George W. Lord Company, miniature barrels for watch charms and art calendars for the women.

Pacific Hardware & Steel Co., miniature watch charms made of drill points and 18-inch steel pocket rules.

Wm. Powell Company, a watch fob of green leather with gilt pendant reproducing a Powell valve in miniature.

Bird Archer Company, medallions, pocket knives and glass paper weights for the men and the ever-necessary pocket mirrors for the women.

Dearborn Drug & Chemical Works, desk blotters, "jumping frogs" and trick lead pencils which could not be used for practical purposes; small bottles of cologne for the women.

THE LUCKY NUMBER

The lucky number in the drawing held at H. W. Johns-Manville Company's San Francisco office after the Mechanics' Fair, last week was 352, held by Mr. C. P. Weiland, First and Mission streets, consulting engineer for Schilling & Co. The prize was a set of Brown & Sharpe micrometers.

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POWER AND GAS

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[illegible] advance [illegible] will be accepted up to noon of Monday [illegible] week. [illegible] advertisers should [illegible] advance of date of [illegible]

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PACIFIC LUMBERMAN, CONTRACTOR AND ELECTRICIAN

CONTENTS

Defense of Mathematics

A toast recently given at a banquet "Here's to mathematics! May it never be of any use to anybody," indicates an unfortunate feeling of antipathy for figures that exists in the minds of many practical men. Most of them are unconsciously making daily use of methods and machines whose first principles were deduced by mathematicians. The micrometer with which they measure their work and the [illegible] they may wear are alike dependent upon the mathematician for their correctness. This antipathy is much akin to the scorn for theory in general and is one exception to the old adage "familiarity breeds contempt." The sentiment is turned to one of respect when we consider how soon this world of ours would go awry if astronomers could not give us the time, if bankers could not account for our money and if engineers built bridges by guess work.

The relation between the mathematician and the mechanic is much like that between the explorer who discovers a country and the settler who develops it. A mathematical calculation, once made, blazes the trail of those who come after.

Like any tool it gives the best results when skillfully used. A mistake in numerical substitution in a trigonometric formula may be as disastrous as putting the decimal point in the wrong place. It requires judgment to decide how far to carry the refinements of a calculation which involves [illegible] approximations. It is [illegible] actual results coincide with those [illegible]. An indicator card on a steam en[illegible] the [illegible] of the one plotted from [illegible] the latter can be easily made before going [illegible] what may prove to be [illegible]

[illegible] two methods may [illegible] European and [illegible] water wheels. The early Ameri[illegible] those of the impulse type, [illegible] a machine [illegible] the most power [illegible] the water and that [illegible] Swiss engineers [illegible] with the mathe[illegible] turbines, the purpose [illegible] and to reduce to [illegible] shock of the entering [illegible] type has proved as [illegible] design being nearly iden[illegible] the other.

[illegible] manufacturers are [illegible] results of calcula[illegible] calculations are [illegible] this issue by Mr. [illegible] mathematical [illegible] water wheels which [illegible] the math[illegible] the power [illegible] analyzing [illegible]

PERSONALS.

Mr. Paul Seiler, senior member of the Seiler Electric Company, San Francisco, is in the East on a business trip.

J. C. H. Stut, consulting engineer, San Francisco, left June 21st for a two weeks' stay in the country.

Mathias Klein & Sons Company of Chicago, manufacturers of linemen's tools, announce the appointment of Harman S. Sal, 111 Liberty Street, New York, as their New York representative.

J. B. Becker, formerly with Baker & Hamilton, has opened an office as manufacturers' agent in the Sheldon Building, San Francisco, with a line of boilers, engines, pumps, motors and laundry machinery.

Heinrich Homberger has opened an office as consulting engineer, making a specialty of hydraulic power and manufacturing plants, at room 865 Pacific Building, Fourth and Market Streets, San Francisco.

J. H. Hill Jr., of the Schenectady office of the General Electric Company, will spend the next two months in Seattle, where he will be regularly in attendance at the exhibit of the company at the Alaska-Yukon-Pacific Exposition.

ANNUAL CONVENTION NATIONAL ELECTRICAL CONTRACTORS' ASSOCIATION.

The National Electrical Contractors' Association will hold its ninth annual convention at Toledo, Ohio, on July 21st, 22d and 23d. A cordial invitation is extended to all electrical contractors who have [illegible] the Association [illegible] the meeting.

There will be open sessions on [illegible] 22d at which speakers from every branch of the electrical [illegible] will [illegible] interesting and instructive.

July 23d will be given [illegible] which will include a boat excursion to [illegible] Island, where field sports and a baseball game between teams from the East and West will take place.

On the evening of July 22d two separate banquets will be held, one for [illegible] and [illegible] for women.

Headquarters at Toledo during the convention will be at the Boody House. Further information on the subject can be secured by application to W. H. Morton, National Secretary, Utica, N. Y.

THE TUESDAY CLUB PLAYS GOLF.

The last weekly luncheon of the San Francisco jobbers was held at the Claremont Country Club, Oakland, on June 22d, 1909, and following the luncheon an eighteen-hole tournament of golf was played with the following results:

	Handicap	Gross	Net
F. H. Woodward	40	132	92
R. J. Davis		93	93
C. L. Gilson	40	136	96
W. L. Goodwin	20	116	96
E. M. Scribner	10	109	99
R. D. Holabird	4	104	100
W. S. Berry	20	123	103
T. E. Bibbins	27	133	106
A. H. Elliott	40	148	108
G. A. Knoche	23	133	110

The prizes played for were two boxes of golf balls, one to the player making the lowest gross score, which was won by R. J. Davis, 93, and the other to the player making the lowest net score, which went to F. H. Woodward, whose score was 132, his handicap of 40 resulting in a net score of 92.

The jobbers are now planning to hold one of their luncheons in each month at some country club in the vicinity of San Francisco and to make this feature of the organization a regular one in future. On the invitation of R. J. Davis, the next tournament will probably be held at the grounds of the Marin Club in Ross Valley.

ELECTRICAL PARADE AT PORTLAND.

An electrical parade was a prominent feature of the Portland annual rose festival held during the first part of June. It consisted of sixteen floats mounted on trolley trucks. These were headed by a big touring car brilliantly illuminated with incandescent lamps and followed by a car carrying the festival officials and set off with stars and crescents of electric lights. After it came the imperial car bearing the representative of the festival king enthroned before two great roses. The other cars were lavishly decorated in keeping with the spirit of the occasion. The display made such an impression that it was repeated by request.

TRADE CATALOGUES.

Westinghouse electric motors for the office, store and home are illustrated and described in application in a new booklet, Folder No. 4132, from the Westinghouse Electric & Manufacturing Company.

Chicago Fuse Wire & Manufacturing Company, 170 South Clinton Street, Chicago, has issued a revised price list of National Electric Code Standard fuses and blocks, 250 and 600 volts, effective June 5, 1909.

"Lubrication versus Friction," is the title of an attractive and interesting booklet from the Dearborn Drug and Chemical Works of Chicago. It gives scientific reasons why one lubricant is preferable and details the processes by which this is determined.

The General Electric Company has just issued bulletin No. 4662 covering Thomson Recording Wattmeter for Switchboard Service. This bulletin illustrates and describes the various types of wattmeters and their parts, and in addition gives dimensions and connection drawings.

The General Electric Company has issued Bulletin No. 4667, which contains a description and numerous illustrations of aluminum lightning arresters for alternating current circuits. Dimensions and diagrams of connections for circuits of from 2000 to 110,000 volts are also shown.

The General Electric Company has issued Bulletin No. 4663 covering lightning arresters for both alternating and direct current circuits. The bulletin gives detailed information with regard to the construction and design of the various types of multi-gap arresters, together with curves, illustrations, dimensions and connections. These cover not only the arresters but also the auxiliary apparatus, including disconnecting switches, choke coils, horn gaps, etc.

TRADE NOTES.

The Decker Electric Company, formerly at 157 Minna Street, is now located at 115 New Montgomery Street in the remodeled Standard Building.

O. C. Goeriz & Company announce their removal on July 1st from their present location, 73 Fremont Street, San Francisco, to the Postal Telegraph Cable Building, at Market & Battery streets.

The Holabird Electric Company announce their permanent location at 1247 Utah Street, Seattle, Wash., at which point their business will be under the management of Everett J. Dwyer, formerly with the San Francisco house.

INDUSTRIAL

EXHIBITS AT MECHANICS FAIR.

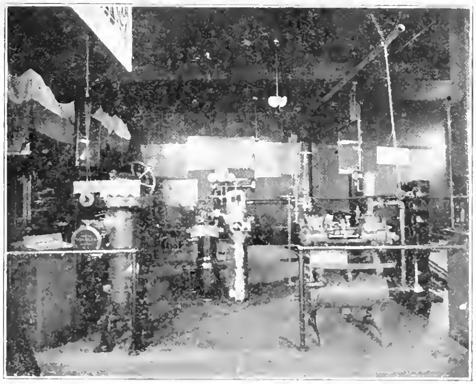
One of the most striking and characteristic exhibits was that of the GEORGE H. TAY COMPANY, San Francisco. It consisted entirely of brass and iron valves, pipe and fittings handled by this firm, the main feature being a 15-foot triumphal arch of 14 and 12-inch pipe, and flange fittings, the keystone being a 12-inch Scott valve. Connected to this and forming the railing of the space was a 6-inch pipe header fitted with Scott pop safety gate globe and angle valves. As a brilliant background there was a complete display of brass valves for all services, made by the Roe Stephen's Manufacturing Company of Detroit (the inventors and patentees of the Scott valves) for whom George H. Tay Company are exclusive selling agents for California and Nevada. The exhibit was in charge of Theo. F. Dredge, manager, assisted by G. H. Waymouth, W. M. Boyd, B. B. Purcell, J. V. Hogshead, F. Raage and H. Graunlich, all of whom assisted at the opening and some of whom were present at all times during the exhibition.

THE GARLOCK PACKING COMPANY of 670 Howard Street, San Francisco, made a display of fibrous and metal packing, their show case displaying cut ring packings and pure copper braided wire which has been used with great success in the United States Navy attracted a great deal of attention. This exhibit was in charge of J. Hepburn, a member of the San Francisco Stationary Engineers No. 3, C. V. Patterson, manager, Dean Asdale and Fred Travers.

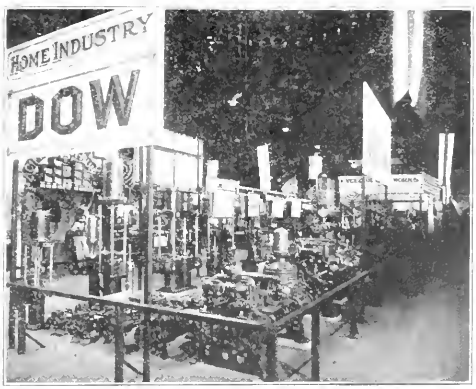
H. R. WORTHINGTON of San Francisco exhibited a fine line of pumps especially adapted to the purpose of the engineer.

The H. W. JOHNS-MANVILLE COMPANY occupied booths 8 and 9, their exhibit being in charge of Frederick S. Mills and W. Locan of their San Francisco office. They displayed asbestos packings of every description to meet all conditions of the steam engineer, pure sheet asbestos with and without wire insertions for high and low pressure steam, also the well known Morris metallic packing, and asbestos roofing, the Standard J-M Brooks brand for meeting all classes of buildings under all conditions, asbestos specialties, the asbestos glove for home use in handling "hot things," made quite a hit and was in great demand, especially by the ladies, several thousand being given away. The asbestos brake band lining known as the "Non Burn" for automobiles, was shown. The H. W. Johns-Manville Company followed out the idea of using their moulded mica socket containing a lighted lamp immersed in a bowl of water. The new Linolite system of lighting was used for out-lining their booth, which was brought out from the factory for this display; this will be used for out-lining buildings quite extensively in the future instead of conduit and the 16 c. p. lamp. The 27½-volt tungsten Linolite lamps were displayed, showing a tungsten lamp of this class will gradually take the place of the 110-volt tungsten for window and show-case lighting. The new desk lamps manufactured in all finishes showed up as well as other Linolite specialties. R. R. O. H. line material was displayed as well as a fine line of porcelain insulators, electroleums and insulating materials. Their new service boxes of 60 amperes up to 400 amperes were quite a novelty. The booth set off with asbestos pipe covering which was a credit to the company.

The FEES SYSTEM COMPANY, Inc., in booths 226 and 229 exhibited their automatic smokeless method of burning crude oil in ranges and steam heating plants; they state that this system is being very generally adopted by the leading hotels on the Pacific Coast.

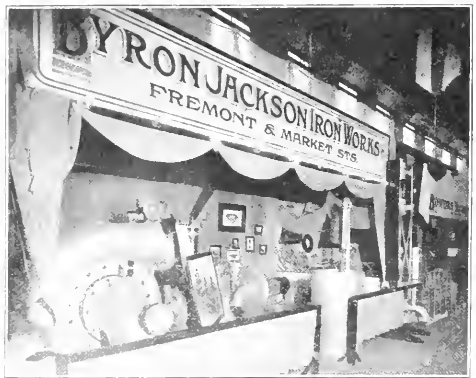


CHAS. C. MOORE & COMPANY, San Francisco, exhibited many special features and appliances of interest to power plant engineers. The Moore patent automatic fuel oil regulating system, which automatically controls the oil and steam to burners, and the opening and closing of the dampers mechanically attracted a great deal of attention, due to the fact that this regulation is obtained mechanically so that it does not depend upon the fireman to regulate his fires or his pressures as the load fluctuates. Many mechanical means of boiler tube cleaning, as manufactured by the Lagonda Manufacturing Company, including Weinland power tube cleansers, Lagonda reducing valves, Chapman valves for steam and water, Sandusky stocks and dies and a model of cylindrical brass condenser mounted over combined air and circulating pump, as manufactured by the Wheeler Condenser & Engineering Company, were also on exhibition. The Turner oil filter and purifier, a single Moore fuel oil pumping system, a Reliance safety column, a Stratton steam separator and Goubert feed water heater were also displayed. There was on exhibition a Sandusky Foundry & Machinery Company light pattern triplex power pump.



Occupying booths Nos. 211, 212, 213, 242, 243, 244, the GEORGE E. DOW PUMPING ENGINE COMPANY exhibited a full line of pumps, all of home manufacture, which compared very favorably with foreign products. This booth attracted a great deal of attention for its arrangement and the style and finish of the work exhibited.

THE ALLIS-CHALMERS COMPANY, 599 Mission Street, San Francisco, occupied booths 227 and 228 but made no exhibit of their products; in lieu of an exhibit their booth was arranged as a reception room done in old mission style. Their display included framed pictures of their manufacturing plants and notable installations, together with bound volumes of photographs of machinery manufactured by them. Samples were shown of turbine blades and interesting details of some of their equipment with special alternating current features. Their booth was a restful meeting place for the renewal of old friendships and the making of new. It was in charge of G. B. McLean who has but recently become associated with the Allis-Chalmers Company after having severed his connection with Chas. C. Moore & Company.



THE BYRON JACKSON IRON WORKS of San Francisco, booths 100, 101, 102 and 103, had an unusually interesting exhibit of pumps which included the following typical examples of their manufacture: One Class A seven-inch horizontal centrifugal pump, 1 standard 7-inch horizontal centrifugal pump, 1 sand and gravel six-inch horizontal centrifugal pump, 1 direct connected three-inch horizontal centrifugal pump, 1 belt driven two-inch horizontal centrifugal pump, 1 belt driven three-quarter-inch horizonal centrifugal pump, 1 four-inch one-step vertical pump in frame, 1 three-inch two-step vertical pump in frame, 1 ten-inch well pump showing how the pump enters the casing—installed within itself in the casing. A photograph included in the exhibit and which attracted a great deal of attention was thirty-six inches by 40 inches in size, showing the new fire pumps for the two fire-boats recently built for the City of San Francisco. This company was represented during the week by Mr. Colby, Mr. Boyer, A. L. Martin, C. C. Seydel.

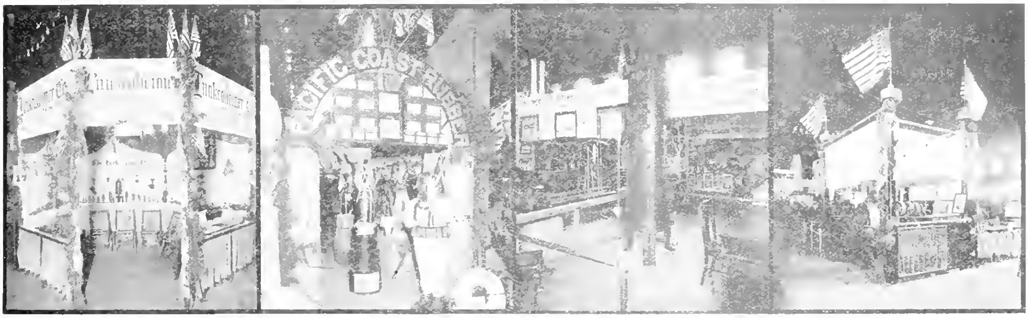
[illegible] HUGHS [illegible] [illegible] tished in 18[illegible] [illegible] plant [illegible]

[illegible] HARDWARE & STEEL CO. [illegible] San Fran[illegible] [illegible] W. [illegible] [illegible] Station [illegible]

[illegible] BIRD-ARCHER COMPANY OF NEW YORK, manu[illegible] [illegible] for boiler feed water, who [illegible] at San Francisco, were repre[illegible] [illegible] K. J. Peterson, who not only dis[illegible] [illegible] the subject of boiler compound and [illegible] also distributed some very desir[illegible] [illegible] the shape of jack knives and razors; to [illegible] for souvenirs of this character they [illegible] buttons which were pinned upon all [illegible] to stop at the booth. The gold medal bearing [illegible] Home Ain't Nothing Like This" was pre[illegible] [illegible] engineers who, without a dissenting [illegible] that the inscription was correct.

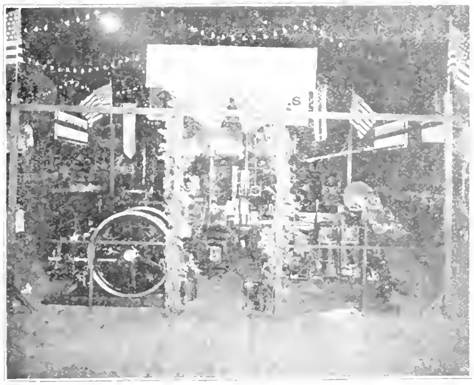
A [illegible] of engines, pumps, boilers and other [illegible] shown in the booth operated by the CALI[illegible] HYDRAULIC ENGINEERING AND SUPPLY CO. [illegible] C. W. Martin, general manager for the Coast, was in per[illegible] of the booth, assisted by P. H. Coop and L. U. [illegible] The display consisted of centrifugal pumps, [illegible] machines, steam turbines, engines and [illegible] together with boilers and a general line of [illegible] equipment.

[illegible] WITT COMPANY, 1165 Howard street, San Fran[illegible] [illegible] booths 168 and 169, illustrated the different [illegible] which their oil-burning products can be used. [illegible] upright boiler and fire department boilers and [illegible] were shown with the oil-burners installed [illegible] engineers an idea of the possibilities of these [illegible]



THE LUNKENHEIMER CO[illegible]ANY, [illegible] valves, cocks, whistles, gauges, injectors, [illegible] oil [illegible] grease cups, had a display in charge of H. T. [illegible], who has offices in the Call Building.

The vari-colored sign "Rainbow" [illegible] PACIFIC COAST RUBBER COMPANY'S [illegible] only had a fine display of rubber packing [illegible] belting, but was actually built from Rainbow [illegible] and other packings. Fire extinguishers, [illegible] various other sundries added to this unique display. The construction of this booth was designed and carried [illegible] W. Webb, who also managed same during the [illegible].



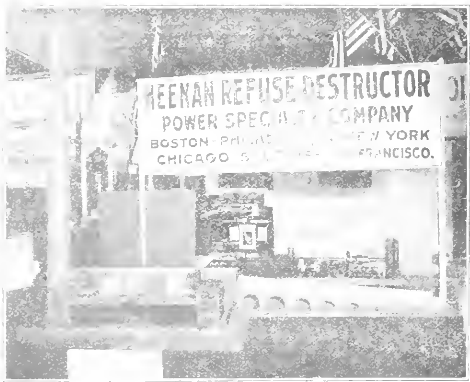
HENSHAW-BULKLEY C[illegible] San Francisco, occupied booths [illegible] a complete line of machine tools [illegible] most modern shop practice, [illegible] speed tools are demanded. Their [illegible] interesting one: to meet existing [illegible] and [illegible] mands they have a line of improved [illegible] and energy, the general construction [illegible] valuable for high speed production [illegible] and durability. The exhibit was in charge [illegible] sisted by Mr. Murray of the San Francisco house.

THE GEORGE W. LORD COMPANY [illegible] Francisco by H. L. Gaskill and R. Ingram [illegible] street, occupied booths 216 and 239 with an exhibit [illegible] compound. Their specialty is the analyzation of water.

Visitors who were attracted to the booth of HARRON, RICKARD & McCONE by a large ball which seemed to float in the air discovered that the ball was kept in this position by an American Blower operated by a [illegible] Gas Engine [illegible] city gas. This firm has a full line of [illegible] boilers, mining machinery, air compressors, [illegible] and general supplies. The office [illegible]

THE DAY [illegible] WATER HEATER AND PURIFIER [illegible] F. Day, 215 Spear [illegible] noted for its simplicity [illegible] the ease with which the [illegible] replaced. It is well known [illegible] feed water is a problem [illegible]

[illegible] Main street, had a booth [illegible] transmission of power. The [illegible] and most efficient means [illegible] explained by the men in the [illegible] bearings, stands, shaft [illegible] many other transmission con[illegible] Nineteenth and Harrison streets, San Francisco.



THE POWER SPECIALTY COMPANY, Kohl Building, San Francisco, [illegible] which was in charge of [illegible] Their [illegible] showing a section of [illegible] Various [illegible] recommended [illegible]

[illegible] CO., Booth [illegible] drill [illegible]

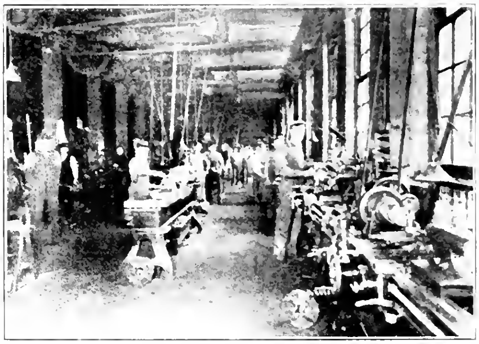
[illegible]

BROOKS-FOLLIS ELECTRIC COMPANY, 41 Second Street, San Francisco. This exhibit occupied booths 96 and 97 and was an unusually interesting one to the general public. It included the enormous gongs which responded to the pressure of the button by Mayor Taylor upon the opening night which was the signal for the beginning of operations. Some of their other attractions were a miniature railway in full operation, a miniature power plant which furnished light for a toy village surrounding the railway station, electric vibrators, wireless apparatus, heating devices and telegraph instruments. This exhibit was constructed by L. Schaefer and W. Burns who were in charge during the week.

THE GORHAM RUBBER COMPANY showed a complete line of belting, hose, packing and moulded rubber goods from their San Francisco factory, where twenty men are continually employed. They also showed an interesting line of fire department supplies, including the Sieman Chemical Engine. This firm makes a specialty of rubber clothing, footwear, oil clothing, etc. The booth was in charge of E. Hickman and W. H. Manuell. A complete and simple 6-horsepower gas engine was shown by the Gorham Engineering Company of Alameda. This engine was very favorably commented upon by engineers and visitors. Mr. Ramsey had charge of the exhibit.

THE DEARBORN DRUG COMPANY & CHEMICAL WORKS occupied booths 189 and 267 which were handsomely decorated in honor of their 21st birthday, they having been twenty-one years in the business of treating boiler feed water.

The booth of BAKER & HAMILTON, Fourth and Brannan Streets, San Francisco, was in charge of T. M. Harrod, who devoted his time to demonstrating the fact that the Peerless line is true to its name. Steam boilers and engines were shown from 1 h. p. upward, together with gasoline from $1\frac{1}{2}$ h. p. upward for all purposes. Wagener steam pumps were also shown.



Machine Shop of Powell Valve Factory.

The neat display of the WM. POWELL COMPANY of Cincinnati manufacturers of dependable engineering specialties, including the well known Powell valves, was in charge of J. L. Chiles, their Pacific Coast representative, and added materially to the handsome machinery display of the Baker & Hamilton Company of San Francisco.

Five salesmen from the LALLY COMPANY were kept busy showing and explaining interesting exhibits of valves, engine trimmings, gauges, oiling devices, engine indicators, and inspectors test outfits. A special feature was an 8-inch Ludlow iron body valve, suitable for 1500 pounds working pressure, probably the heaviest valve of its kind on the Coast. Lally Company's headquarters are at First and Folsom streets, San Francisco.

THE PACIFIC TOOL & SUPPLY COMPANY of 100 and 102 Mission Street, San Francisco, exhibited a complete line of machine tools, shop equipment and supplies including Brown & Sharp milling machine, gray planer, Hendy-Norton engine lathe, Bradford engine lathe, Star lathe, Hendy-Norton shaper, Potter-Johnson shaper, Whitney Manufacturing grinder, Diamond grinder, Hoefer drill press, New Britain post vise, New Britain post tool rack, Knecht friction drill press. This exhibit was in charge of O. W. Fairfield.

DUNHAM, CARRIGAN & HAYDEN COMPANY, 131 Kansas Street, San Francisco, occupied booth No. 1 in which was arranged an instructive exhibit, including enclosed fuses and wall boxes manufactured by the Chicago Fuse Wire & Manufacturing Company, Chicago, heating devices of the American Electric Heating Company, Detroit, Mich., lighting specialties of the Marshall Manufacturing Company, Hyde Park, Mass., with a general line of their well known brand of "Clean Cut" tools and steam fitting material. This exhibit was in charge of John Eagan and H. S. Engle.

In booth No. 190, SQUIRES & BYRNE CO. exhibited home industry in the matter of ring and spiral packings of all descriptions. The factory is located at 52 Steuart Street.

A Victor "Balata" Belt running in water was a special attraction of the STERLING RUBBER COMPANY, 166 Second Street, San Francisco, and kept C. A. Tracy busy explaining the non-stretching, moisture, oil and steam resisting qualities of the belt. They also showed Kantleek Red Sheet packing, a new product put up by the Seamless Rubber Company.

The exhibit of the WAGNER ELECTRIC MANUFACTURING COMPANY of St. Louis, Mo., consisted of a full sample line of their manufactured product, including poly-phase and single-phase motors in the various styles now being built by them. Also a complete line of electrical instruments was shown consisting of voltmeters, amperemeters, wattmeters, series and pressure transformers of both switchboard and portable type. Mr. C. W. Langstaff was in charge of the exhibit.

THE PARAFFINE PAINT COMPANY exhibited their well-known preservative paints and roof-coverings and demonstrated the advantages of using their paints for stack and boiler work and other miscellaneous purposes. These products being home manufacture, were naturally found of great interest.

W. P. FULLER COMPANY had on display a line of paints and oils, including Pioneer White Lead and Havoline Cylinder Oil, which is being largely used by automobilists.

NEWS NOTES

FINANCIAL.

EL CENTRO, CAL.—The Trustees have adopted a resolution calling an election to vote on a proposition to issue $75,000 bonds for a municipal water system.

SAN FRANCISCO, CAL.—A meeting of the stockholders of the Mojave Water & Power Company will be held on August 11, 1909, to act on the proposition of creating a bonded indebtedness to the amount of $15,000,000.

INCORPORATIONS.

MODESTO, CAL.—Associated Pipe Line Company (an S. P. Co. auxiliary), by E. E. Calvin, W. F. Herrin, C. L. King, W. S. Porter and F. H. Buck.

LOS ANGELES, CAL.—Clyde Jackson Oil Company; capital stock $1,000,000; by C. Jackson, F. C. Carlson, W. A. Cates, G. Kellogg and H. A. Adams.

LOS ANGELES, CAL.—Mountain Water Power Company; capital stock $1,000,000; by J. T. Stanton, W. H. Barrows, J. C. Irvine, W. P. Barry and W. H. Phelps.

TELEPHONE AND TELEGRAPH.

ELY, NEV.—The directors of the White Pine Telephone Company have instructed General Manager Bennett to reconstruct the line between Ely and the mines.

BREMERTON, WASH.—C. J. Farmer of Los Angeles, is at the head of a company which proposes to establish a new telephone system in this vicinity. W. J. Calder of this place is also interested in the matter.

BAKERSFIELD, CAL.—The Kern Mutual Telephone Company has been awarded the West Side telephone franchise for $50. The Home Telephone Company also made a bid but this was not considered, not being made in the proper form.

OROVILLE, CAL.—It is announced by the Pacific States Telephone Company that it will rebuild the telephone system of this city at an expense of about $10,500. It is also proposed to build another long distance line to Marysville, to accommodate the increased amount of business.

SALT LAKE CITY, UTAH.—The Progressive Telephone Company of Lincoln, Tooele County, has filed articles of incorporation with a capital stock of $3,550. The officers are: J. W. W. Whitehood, president; Harriet W. Sagers, vice-president; and Henry W. Droubay, treasurer, and Charles Hanson, secretary.

OAKLAND, CAL.—The Home Telephone Company announces that the biggest order of cable ever placed with any cable manufacturing concern has been satisfactorily filled in Oakland and that six miles of cable, weighing 600,000 pounds and costing $30,000, to be used in connecting Oakland with San Francisco by telephone, has been turned over to the telephone company by the Oakland manufacturers. Preparations are now being made for laying of the cable which will enable the independent telephone lines of Oakland to connect with San Francisco.

TRANSMISSION.

KELOWNA, B. C.—The electric power house at this place was destroyed by fire recently, causing a loss of $10,000.

RENO, NEV.—It is announced that over $50,000 has been subscribed here for the building of an electric railroad from this city to Lake Tahoe.

VANCOUVER, WASH.—A Mr. Vaughn has taken preliminary steps to secure a franchise to bring electric power to the city from Lewis river, where he has a plant.

OROVILLE, CAL.—J. W. Coffin, president of the Messilla Valley Gold Gravel Mining Company, has left for San Francisco to prepare plans for an electric equipment.

SPOKANE, WASH.—The Washington Water Power Company has purchased all the property of the Cable Milling Company, consisting of large flouring mill, grain elevators, etc. The plant will be enlarged and run by electricity instead of water power.

TACOMA, WASH.—One of the largest waterpower plants in the west, capable of developing 100,000 h. p. electrical current, will be erected at Lake Tapp near Sumner, as a result of the visit of C. A. Stone of the Stone-Webster syndicate, which must have additional power for its electric railways.

PORTLAND, ORE.—The fire at the sub-station of the Portland Railway, Light and Power Company a few days ago caused a loss to machinery estimated at about $100,000. Two of the six transformers were ruined by water and two of the rotaries were damaged from the same cause. It will require several weeks to repair the machinery.

NORTH YAKIMA, WASH.—R. E. Strayhorn of the North Coast road announces that $50,000 worth of machinery has been ordered for the Naches valley power house of the Northwest Light & Water Company. Mr. Strayhorn is president of his company which is now building the high power transmission line down the Yakima valley to Kennewick.

LOS ANGELES, CAL.—To prepare the way for completion of hydro-electric plants along the aqueduct way, concurrently with the delivery of Owens river water to the city, the Aqueduct Commission will request the City Council to appropriate from the general fund a sufficient sum to cover the expense incident to preparing plans for power development and the inspection of the most modern hydro-electric machinery.

ILLUMINATION.

SAN JUAN, CAL.—The Board of Trustees has accepted the bid of the San Benito Light and Power Company for a franchise through the town.

OAKLAND, CAL.—The Central Oakland Light & Power Company has applied to the Board of Public Works for a permit to built a two story steel frame electric power station on the north side of First street, east of Alice.

VALLEJO, CAL.—Before the present summer has run its course the Vallejo Gas Company will have spent $60,000 in making the local gas plant larger. Many large mains to replace the small mains that now extend throughout the city are planned.

LOS ANGELES, CAL.—A branch plant will be established in Los Angeles by the Pre-To-Lite Gas Company, of Oakland. A half-acre of ground in the southeast section of this city adjoining trackage of the Santa Fe, has been procured as a site for the factory.

SANTA PAULA, CAL.—This city will try the tungsten lamps in the city lighting system. The Board of Trustees has passed a resolution authorizing the president and secretary to sign a contract with the Ventura County Power Company, for a new lighting system which is to be built and installed immediately.

TRANSPORTATION.

ELLENSBURG, WASH.—Frank S. Farquhar of Tacoma has asked the city for a franchise for an electric railway.

NORTH YAKIMA, WASH.—The North Yakima & Valley Railway has accepted the franchise to operate a street railway in the city.

ROSLYN, WASH.—Work has begun on the proposed Cle Elum-Roslyn Electric Railway by the Cle Elum-Roslyn Electric Railway & Power Company.

GARDNERVILLE, NEV.—The application of H. H. Springmeyer and A. Jensen for a street railway franchise has been granted by the Board of Trustees.

SEATTLE, CAL.—Officials of the Seattle-Tacoma Short Line electric interurban railway announce they will be ready to let contracts for construction of the line in a few weeks.

BOISE, IDAHO.—The stockholders of the Boise Valley electric road have subscribed $73,000 with which to furnish the last five miles of the road into Nampa, and work will begin at once.

NORTH YAKIMA, WASH.—It is announced that Eastern capital has been secured with which to finance the Yakima Transportation for extending its street car lines into the neighboring valleys.

SACRAMENTO, CAL.—A. L. Shinn, attorney for the Central California Traction Company, has presented an application for a franchise on Thirty-first street from X to Y to connect the line through the city east and west with the main line coming in from Oak Park.

BERKELEY, CAL.—The final step in the formal proceedings for the conversion of the local lines of the Southern Pacific in this city to electricity was taken when a resolution was passed by the Board of Trustees, at the request of the railroad officials, giving the company the right to use electricity instead of steam on its Shattuck avenue line.

SACRAMENTO, CAL.—A. M. Seymour, attorney for the Northern Electric Company, has presented an application for a franchise on Second street from N north to M. Mr. Seymour also presented an application for a franchise to lay a track from the alley, Front and Second, M and N streets, to Front and N, there to connect with the belt line and wharf.

SALINAS, CAL.—The Board of Supervisors have received a bid from H. R. O'Bryan for an electric street railroad franchise to run from the corner of the Hotel Del Monte grounds to Del Monte Heights, a distance of about four miles. The franchise will be transferred to a corporation which is being formed to be called the Monterey and Del Monte Street Railroad Company.

OAKLAND, CAL.—Active work on the proposed new Key Route line along Sacramento street, from the Oakland line to the extreme northern section of Berkeley was inaugurated last week, when a force of men began the work of grading a private right of way in Northern Oakland to connect the [illegible] with the Adeline street trunk line near Forty-[illegible] street. As soon as this preliminary work is completed [illegible] along Sacramento street will be commenced and the company hopes to have the new road in operation within [illegible] months. The franchise covers the whole length of Sacramento street in Berkeley, a distance of five miles. At the [illegible] of Sacramento street and Hopkins in the Peralta [illegible] the road will [illegible] one line running north east along Hopkins street to Grove and thence north through the newly annexed [illegible] to what is known as the Capitol [illegible]. The second [illegible] will extend northwest from the dividing [illegible] the Santa Fe tracks [illegible] of Ocean View and across the county line to the Richmond district. The trunk line on Sacramento street, which will be constructed first, will be double track, with the trolley poles between. The same power that operates the road will furnish light for ornamental arc lamps, which will be installed at every crossing by the corporation.

SANTA ROSA, CAL.—The City Council at its last meeting was asked to grant another franchise for a railroad from this city to Lake County. Recently it granted a franchise to the Clear Lake and Sonoma County Railroad to run its cars along certain streets of the city. Now the Sonoma and Lake County Railroad, from Santa Rosa to Cloverdale and Lakeport, wants a similar franchise. The Hon. John T. Campbell who appeared at the time the former franchise was granted as the legal representative of the Santa Rosa-Clear Lake, also appeared to represent the Sonoma-Lake County road, and asked for the granting of the new franchise. The Sonoma-Lake County road will have a standard broad gauge, instead of a narrow gauge as proposed by the Clear Lake road. According to the petition presented the work of construction is to be commenced within three months after the granting of the franchise and finished within one year.

OIL.

SAN DIEGO, CAL.—M. Russell is preparing to begin operations for development of oil in Paradise Valley.

BAKERSFIELD, CAL.—Two Japanese, claiming to be agents of the Japanese government, have been seeking to obtain an option upon a section of land from the Mount Diablo Oil Company. The Mount Diablo named $1,000,000 as the price.

SACRAMENTO, CAL.—A deed has been filed with the county recorder by Donzel Stoney and Emille S. Stoney, conveying to the Union Oil Company ten acres of land lying close to the river front. Upon the property will be erected the company's tanks and shops.

SAN FRANCISCO, CAL.—W. F. Buck, manager marine department Associated Oil Company, has requested that all bills be hereafter made out against the Associated Transportation Company, instead of Associated Oil Company, and that the former company be placed on credit dockage list—filed and granted.

McKITTRICK, CAL.—The Silver Bow Company has recently demonstrated that there is more oil beneath the ground in its immediate vicinity than was suspected, by deepening one of its wells from 900 to 1110 feet. This well has been doing between 400 and 500 barrels every day for the past six weeks. Previous to the re-drilling it made not more than 50 daily at its best. The example thus set is to be followed by the State, adjoining, which will send down its No. 5 to 1100 feet. Oil was encountered in this hole at 542 and it has been rich oil sand ever since.

SAN LUIS OBISPO, CAL.—Surveyors for the Associated Oil Company, who are fixing the route for the proposed pipe line from McKittrick to Gaviota, have reached the west slope of the Tepusquet grade, and their work is nearly done. The route selected crosses the Temblor range of mountains some four or five miles south of McKittrick, then passes over the Carrisa plains, thence to the Cuyama Valley, and on through the Narrows, up to the Buckhorn Canyon and over the Tepusquet to the Santa Maria Valley, where it will connect in Cat Canyon with the present pipe line from the Palmer company's well to the ocean at Gaviota. The distance from McKittrick to the Lewis pumping station on the Cat Canyon line will be about 70 miles. The new pipe line will serve the double purpose of giving easy and cheap transportation for the oil of the McKittrick field, and will furnish the Associated sufficient oil at Gaviota to meet the demands of the Japanese

TRADE MARKS

Classified List of Advertisers, and Material They are Prepared to Furnish.

There is a Court of Arbitration to which the Manufacturer can appeal without the consent of his competitors. It is composed of the great buying public the consumer — who will listen with a willing and eager ear to the story of quality.

Take your case before this court with your strongest arguments and state your reasons for appreciation.

SHOW YOUR TRADE MARK

Explain how this trade-mark or name will identify your goods, prevent substitution and protect the purchaser. If this be properly done, victory will be yours.

ADAPTERS

Lamp Adapters

American Ever Ready Co
Benjamin Electric Mfg. Co.
Bryant Electric Co.
Dale Co.
General Electric Co.
Hubbell, Harvey.
Perkins Elec. SwtchMfg.Co

ALARMS.

Burglar Alarms

Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc.
Western Electric Co.

Fire Alarms

Edwards & Co.
Partrick,Carter&WilkinsCo.
Western Electric Co.

Water Alarms

Partrick,Carter&WilkinsCo.

ANCHORS

Johns-Manville Co., H. W., "J. W."
Kierulff, B. F. Jr. & Co., "Hubbard."
Klein & Sons, Mathias.

ANNUNCIATORS

Edwards & Co.
Elec. Goods Mfg. Co., "Ross," "Rivol," "Perfect," "Noxall."
Patrick, Carter & Wilkins Co., "King."
Standard Elec. Works, "C. & S."
Stanley & Patterson, Inc.
Telephone & Elec.Equip.Co. "Holtzer-Cabot & Co."
Western Electric Co.

ARMS.

Cross Arms

American Cross Arm Co. "Walworth & Neville."
California Pole & Piling Co.
Kierulff, B. F., Jr. & Co.
Walworth & Neville Mfg. Co.
Western Electric Co., "Walworth & Neville."

Mast Arms

Elec. Appliance Co., "Cutter."
Ft. Wayne Electrical Wks
Kierulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher."

Desk Phone Arms

Dean Electric Co.
Electric Appliance Co., "Eaco."
Kierulff, B. F., Jr. & Co., "Sterling"

INDEX TO ADVERTISEMENTS

Sterling Elec. Co.
Western Elec. Co.

ASBESTOS

Johns-Manville Co., H. W.

AUTOMOBILE ACCESSORIES

American Eveready Co., "Ever Ready."

BATTERIES

Dry Batteries

American Ever Ready Co. "Ever Ready" and "Crescent."
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "1900."
Elec. Goods Mfg. Co., "Samson Semi-Dry."
Kierulff, B. F., Jr. & Co., "Columbia," "King."
Sterling Elec. Co., "Bear," "Sequoia."
Standard Electric Works, "Standard."
Stanley & Patterson, Inc., "Exeter," "Matchless."
Western Electric Co., "Blue Bell," "Liberty."

Dry Battery Holders

Brooks-Follis Elec. Corp.
Stanley & Patterson, Inc., "Patterson."

Medical Batteries

Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Electro - tonic," "Vetter."

Wet Batteries

Brooks-Follis Elec. Corp.
Elec. Goods Mfg. Co., "Samson," "Noswas."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Gold Medal," "Faraday."
Western Electric Co.

Storage Batteries

Elec. Storage Battery Co.
Westinghouse Machine Co.

BELLS

Electric Bells

Brooks-Follis Elec. Corp.
Edwards & Co., "Rex," "Lungen."
Electric Appliance Co., "Ansonia."
Elec. Goods Mfg. Co., "Victor," "Dandy," "Tyrolean."
Partrick,Carter&WilkinsCo.
Stanley & Patterson, Inc., "Faraday," "Columbia," "Liberty."
Western Electric Co., "Hawthorne."

Electro-Mechanical Gongs

Brooks-Follis Elec. Corp.
Edwards & Co.
Electric Goods Mfg. Co.
Partrick,Carter&WilkinsCo.

Magneto Bells

Brooks-Follis Elec. Corp.
Dean Electric Co.
Elec. Appliance Co., "Eaco."
Electric Goods Mfg. Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Kellogg Switchboard & Supply Co.
Standard Electric Works, "C. & S."
Western Electric Co.

BOILERS

Henshaw, Bulkley & Co.
Moore & Co., Chas. C., "B. & W."
Tracy Engineering Company, "Edge Moor."

BOXES

Floor and Outlet

Krantz, H., Mfg. Co.

Junction Boxes

Krantz Mfg. Co., H.

Wall Boxes

Brooks-Follis Elec. Corp.
Benjamin Elec. Mfg. Co.
Bossert Electric Construction Co., "Bossert."
Chase Shawmut Co., "Knockout."
Chicago Fuse Wire & Mfg. Co., "Union."

Wanted and For Sale

The rate for advertisements in this column is $1.00 per insertion for 25 words or less; additional words 2 cents each, payable in advance. Remittance and copy should reach this office not later than Monday noon for the next succeeding issue.

Replies may be sent in care of the Journal of Electricity Power and Gas 604 Mission Street, San Francisco.

WANTED—Back numbers of the **Journal of Electricity, Power and Gas.** We have numerous calls for back numbers, which we are unable to fill, and subscribers having back numbers on hand will confer a favor upon us by mailing us a list of what they have. On receipt of such list we will name the price we are willing to pay.

Journal of Electricity, Power and Gas,
604 Mission Street, San Francisco.

AGENTS WANTED on a guaranteed weekly salary to represent our two publications, "Southern Engineer" and "Southern Machinery"; liberal terms for exclusive services; easy sellers; every engineer and every machinist is interested. Write at once. For further information, address W. R. SMITH PUB. CO., Sub. Dept. Atlanta, Georgia.

WANTED—Men coming in direct touch with Steam, Electrical Superintending Engineers and Shop Foremen. A proposition that can be handled by energetic persons to good advantage. Liberal commission and permanent work. CHAS. L. TURNER, 907 Atlas Bldg., San Francisco, Cal.

SITUATION WANTED—By electrical engineer with 15 years' experience in designing and estimating of electric power plants, switch gears, light, motor and storage battery installations; also in central station service. Advertiser takes also draughting work in this line as home occupation if no steady engagement can be attained. Moderate expectations. Address Box 101, **Journal of Electricity.** San Francisco.

Cutter Co., The, "Munit."
Electric Appliance Co., "T. & B."
General Electric Co.
Krantz Mfg. Co., H.
Paiste, H. T. Co.
Pass & Seymour.
Sprague Electric Co., "Universal."
Standard Electrical Works, "M. & M."
Stanley & Patterson, Inc., "Simplex."
Telephone & Elec.Equip.Co. "Pratt Chuck Co."

BRACKETS

Desk Telephone Brackets

Brooks-Follis Elec. Corp.
Stanley & Patterson, Inc., "Imperial."
Sterling Elec. Co., "Equipoise."
Western Electric Co.

Iron Pole Brackets

Benicia Iron Works.
Elec. Appliance Co., "Cutter."
Kierulff, B. F., Jr. & Co., "Cutter."
Pierson, Roeding & Co.
Western Elec. Co., "Fletcher."

BURNERS

Gas Lighting Burners

Edwards & Co.
Electric Goods Mfg. Co., "Advance."
Western Electric Co., "Edwards."

CABINETS

Special Cabinet Work

Krantz, H., Mfg. Co.

Metal Cabinets

Krantz, H., Mfg. Co.

CABLES

Submarine and Lead-Covered

Electric Appliance Co., "Paranite."
General Electric Co.
Habirshaw Wire Co., "Habirshaw."
Kierulff, B. F., Jr. & Co., "National."
Okonite Co., "Okonite."
Roebling's Sons Co., John A., "Tolma."
Safety Ins. Wire & Cable Co.
Standard Underground Cable Co.
Simplex Electrical Co., "Simplex."
Western Electric Co., "Hawthorne."

Paper Insulation

Belden Manufacturing Co.
Western Electric Co.

Telephone Cable

Dean Electric Co.
Kellogg Switchboard and Supply Co.

CARBONS

Arc Light Carbons

Brooks-Follis Elec. Corp. "Siemens."
Reisinger, Hugo, "Electra," "Nuernberg."

CIRCUIT BREAKERS

Cutter Co., The "I-T-E," "Dalite."
Ft. Wayne Electric Works.
General Electric Co.
American Ever Ready Co.
Kierulff, Jr. & Co., B. F. "Hartman."
Pacific Electric & Manufacturing Co.
Western Elec. Co., "I-T-E," "Dalite."
Westghse Elec. & Mfg. Co.

CLAMPS

Ground Clamps.

Belden Manufacturing Co.
Bossert Electric Const. Co.
Chase - Shawmut Co., "Shawmut."
General Electric Co.
Paiste Co., H. T. "Perma-Effect."
Thomas & Sons Co., R.
Weber Elec. Co., H. D.

CLEATS.

Fibre Cleats

Blake Signal & Mfg. Co.
Brooks-Follis Elec. Corp.

Porcelain Cleats

Brooks-Follis Elec. Corp.
General Electric Co.
Pass & Seymour
Standard Electrical Works, "Standard."
Star Porcelain Co.
Sears, general sales agent.
Western Elec. Co., "Thomas."

COILS

Armature and Field Coils

Belden Manufacturing Co.
General Electric Co.
Western Electric Co., "Deltabeston."
Westghse Elec. & Mfg. Co.

Induction Coils

Electric Goods Mfg. Co.
Kellogg Switchboard and Supply Co.
Partrick,Carter&WilkinsCo.
Western Electric Co.

Spark Coils

Electric Goods Mfg. Co.
Western Electric Co.

COMPOUNDS

Boiler Compounds

Dearborn Drug & Chemical Works
Johns-Manville Co., H. W., "Magic."

CONDUIT

Flexible Conduit

American Circular Loom Co., "Circular Loom."
Sprague Electric Co., "Greenfield."
Telephone & Elec.Equip.Co. "Flexduct."

Rigid Conduit

American Circular Loom Co., "Electroduct."
Elec. Appliance Co., "Galvaduct," "Loricated."
Kierulff, B. F., Jr. & Co., "American."
Roebling's Sons Co., J. A., "Navalite."
Sprague Electric Co., "Iron Armored."
Telephone & Elec.Equip.Co. "Economy."

Underground Conduit

American Cross Arm Co., "Walworth & Neville."
Johns-Manville Co., H. W., "J-M."
Pierson, Roeding & Co., "Fibre."
Roebling's Sons Co., J. A., "Bituminized Fiber."
Western Electric Co. "Walworth & Neville."

CONNECTORS

Cable Connectors

American Ever Ready Co. "Bulldog."
Belden Manufacturing Co.
Chicago Fuse Wire & Mfg. Co.
Kierulff, B. F., Jr. & Co.

CORD

Flexible Bell Cord

Belden Mfg. Co.
Brooks-Follis Elec. Corp.
General Electric Co.
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Roebling's Sons Co., J. A.
Simplex Elec. Co.
Western Electric Co.

Lamp Cord

Belden Mfg. Co.
Brooks-Follis Elec. Corp.
Elec. Appliance Co., "Paranite."
General Electric Co.
Okonite Co., The, "Okonite."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Roebling's Sons Co., John A.
Safety Ins. Wire and Cable Co.
Simplex Elec. Co.
Standard Und. Cable Co.
Western Elec. Co., "Victor."

Telephone Cord.

Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Dean Electric Co.
Kellogg Switchboard and Supply Co.
Kierulff, B. F., Jr. & Co., "National."
Pierson, Roeding & Co., Agents, Elec. Cable Co.
Safety Ins. Wire and Cable Co.
Simplex Elec. Co.
Western Elec. Co., "Victor."

CROSS ARM BRACES.

Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co.

CLUSTERS

Fixture Clusters

Benjamin Electric Mfg. Co. "Anti-Night."
Dale Co.
General Electric Co.
Hubbell, Harvey, "Hubbell."

CUT-OUTS

Arc Cut-Outs

Bryant Electric Co.
Ft. Wayne Elec. Works.
General Electric Co.

Incandescent Cut-Outs

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour.
Paiste Co., H. T., "Shaffer," "K. W.," "P. K.," "Taplets."
Perkins Elec. Swch Mfg Co.
Weber Elec. Co., H. D. Sears, general sales agent.
Westghse Elec. & Mfg. Co.

Transformer Cut-Outs

Bryant Electric Co.
D. & W. Fuse Co.
General Electric Co.
Pass & Seymour
Westghse Elec. & Mfg. Co.

DYNAMOS

A. C. Dynamos

Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co.
Western Electric Co.
Westghse Elec. & Mfg. Co.

D. C. Dynamos

Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.
Standard Engineering Co
Western Electric Co.
Westghse Elec. & Mfg. Co.

ELECTRIC NOVELTIES

American Ever Ready Co "Ever Ready."

ENGINES

Gas and Gasoline Engines

Moore & Co., Chas. C.
Henshaw-Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Kierulff, B. F., Jr. & Co., "American Diesel."
Tracy Engineering Co.
Westinghouse Machine Co.

Marine Engines

Standard Engineering Co., "Engberg."

Steam Engines

Moore & Co., Chas. C.
Henshaw, Bulkley & Co.
Hunt, Mirk & Co., "Westinghouse."
Standard Engineering Co.
Tracy Engineering Co., The
Westinghouse Machine Co.

FANS

A. C. Portable Fans
Brooks-Follis Elec. Corp.
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Standard Electric Works, "Jandus."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

D. C. Portable Fans
Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
Ft. Wayne Elec. Works.
General Electric Co.,"G. E."
Sprague Electric Co., "Lundell."
Standard Electrical Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

A. C. Ceiling Fans
Brooks-Follis Elec. Corp.
Standard Elec. Works, "Jandus," "Century."
Western Elec. Co., "Victor," "Emerson."
Westghse Elec. & Mfg. Co.

D. C. Ceiling Fans
Brooks-Follis Elec. Corp.
Electric Appliance Co., "Colonial."
General Electric Co.
Sprague Electric Co., "Lundell."
Standard Elec. Works, "Jandus."
Western Electric Co., "Hawthorne."
Westghse Elec. & Mfg. Co.

Exhaust Fans
Brooks-Follis Elec. Corp.
General Electric Co.
Standard Elec. Wks., "M. A. Co."
Western Elec. Co., "W. E."
Westghse Elec. & Mfg. Co.

FIXTURES

Ceiling, Bracket and Desk Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.

Marine Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.
Electric Appliance Co.
Sterling Electric Co.

Show Case Fixtures
Benjamin Elec. Mfg. Co.
Dale Co.
Johns-Manville Co., H. W., "Linolite."

Stage Fixtures
Chase-Shawmut Co.,"Shawmut."

FLASHLIGHT (Pocket)

American Eveready Co., "Ever Ready."

FUSE MATERIAL

Enclosed Fuses and Fittings
Bryant Electric Co.
Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co., "Union."
D. & W. Fuse Co.
General Electric Co.
Johns-Manville Co., H. W., "Noark."
Western Elec. Co., "D. & W."
Westghse Elec. & Mfg. Co.

Fuse Boxes
Including Service Boxes, Subway Boxes and Junction Cut-Outs for use with enclosed fuses.
D. & W. Fuse Co., "D. & W."
Johns-Manville Co., H. W., "Noark."

Fuse Wire and Links.
Chase-Shawmut Co.,"Shawmut."
Chicago Fuse Wire & Mfg. Co.
General Electric Co.
Pierson, Roeding & Co., "Aluminum."

Miscellaneous Fuses
Bryant Electric Co.
General Electric Co.

THE VERY BEST MECHANICAL PROTECTIONS FOR ELECTRIC WIRES.

Approved by the Underwriters. *Sold by All Electrical Jobbers.*

"EVERLASTINGLY ON THE JOB."

Genuine "Circular Loom"

The Ideal Flexible Conduit.

Fishes Easily — Thoroughly Flexible Always.
Weatherproof — Waterproof — Fireproof.
Resists Abrasion — Will Not Collapse.

FOR EVERYDAY USE.

"Lutz" Metal Molding

The Practical Metal Molding.

A Compact, Complete and Continuous Raceway for Electric Wires with Fittings for Every Detail of Construction.

The Original Enameled Steel Conduit.

"ELECTRODUCT"

Bends Easily. Enamel Will Not Crack.

AMERICAN CIRCULAR LOOM CO. TRADE MARK REGISTERED

AMERICAN CIRCULAR LOOM CO.,

BOSTON, MASS.

SAN FRANCISCO, 770 Folsom St.

Complete Stock Carried in San Francisco.

SEATTLE, Lowman Building

Dale Detachable Wireless Clusters

FIBRE LINING AND DUST SHIELD

¶ The Dale Detachable Wireless Clusters involve less expense for wiring and installation than any other type of cluster made, and we are ready to prove it to your complete satisfaction.

¶ Made for from two to seven lights. All parts being interchangeable, a body having two lights may be quickly changed to one having from three to seven lights without disconnecting wires.

THE DALE COMPANY

SAN FRANCISCO
770 Folsom St.

NEW YORK CITY
9th Ave. and 13th St.

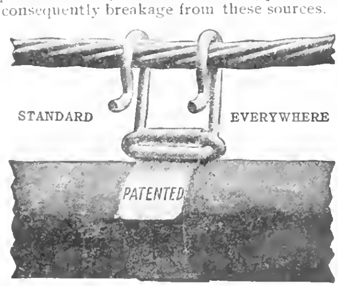
SEATTLE
Lowman Building

Complete Stock Carried in San Francisco.

BOSTON CABLE CLIP

SIMPLEST
STRONGEST
BEST

It consists merely of two pieces of steel wire and a strap of sheet zinc, eliminating rivets, pins or buttons and consequently breakage from these sources.



It is adjustable to different sizes of cable, the straps being furnished in different lengths. Being wholly adjusted by hand it is more easily and firmly attached than any form demanding the use of pliers.

Chase-Shawmut Company

SAN FRANCISCO
770 Folsom Street

NEWBURYPORT MASS.

SEATTLE
Lowman Bldg.

Complete Stock Carried in San Francisco.

Paiste, H. T. Co., "H. & L."
Weber Elec. Co., H. D. Sears, Gen'l Sales Agent.

Telephone Fuses
Dean Electric Co.
D. & W. Fuse Co.
Kierulff, B. F., Jr. & Co., "Sterling."
Standard Elec. Works, "Couch & Seeley."
Western Electric Co.

GOVERNORS.

Water-Wheel Governors
Pierson, Roeding & Co., "Lombard."

GUARDS.

Wire Lamp Guards.
Benjamin Electric Mfg. Co. "Can't Break," "Protectalite."
Hubbell, Harvey
Krantz, H., Mfg. Co.

HANGERS

Cable Hangers
Chase-Shawmut Co., "Boston."
Kierulff, B. F. Jr. & Co., "National."
Standard Underground Cable Co., "Nordyke Support."

HEATING MATERIAL.
Including Cooking Utensils, Soldering Irons, Sad Irons, Etc.
Brooks-Follis Elec. Corp.
Elec. Appliance Co. "American."
General Electric Co.
Johns-Manville Co., H. W. "Electrotherm."
Simplex Elec. Heating Co., "Simplex."
Vulcan Elec. Heating Co., "Vulcan."
Westghse Elec. & Mfg. Co.

HOODS.

Street Hoods
Elec. Appliance Co., "Cutter."
Ft. Wayne Elec. Works.
General Electric Co.
Kierulff, B. F., Jr. & Co., "Cutter."
Western Elec. Co., "Fletcher."

INSULATORS

Glass Insulators
Brookfield Glass Company, "Brookfield."
Elec. Appliance Co., "Hemingray."
Pierson, Roeding & Co., "Locke Triple Petticoat."
Roebling's Sons Co., John A., "Knowles."
Standard Electrical Works, "Standard."
Western Elec. Co., "Brookfield."

High-Tension Insulators.
General Electric Co.
Johns-Manville Co., H. W.
Kierulff, B. F., Jr. & Co., "Ohio Brass."
Pass & Seymour.
Pierson, Roeding & Co., "Locke."
Roebling's Sons Co., John A., "Lima."
Thomas & Sons Co., R.
Western Elec. Co., "Thomas."

Porcelain Insulators
General Electric Co.
Johns-Manville Co., H. W.
Pass & Seymour
Pierson, Roeding & Co., "Locke."
Standard Electrical Works, "Standard."
Star Porcelain Co.
Thomas & Sons Co., R.
Weber Electric Co., H. D. Sears, gen'l sales agent.
Western Elec. Co., "Thomas."

Wood Knobs
Blake Signal & Mfg. Co.

INSULATING MATERIAL.
Belden Manufacturing Co.
Brooks-Follis Elec. Corp.
Kierulff, B. F., Jr. & Co., "Di-electric."